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ELECTRONICS AND ELECTRICAL ENGINEERING

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USSR REPORT

ELECTRONICS AND ELECTRICAL ENGINEERING

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PROCEEDINGS OF FIFTH JOINT PLENARY SESSION OF SCIENTIFIC-TECHNICAL SOCIETIES

ISHUTINA, L. N.

[Abstract] The two scientific-technical societies, of Radio Engineering, Electronics and Communication imeni A. S. Popov and of Instrument Building Industry imeni S. I. Vavilov, held their fifth joint plenary session in October 1984 in Moscow. This session dealt with development of microprocessors and broadening of their applications. Academician V. I. Siforov of the USSR Academy of Sciences emphasized the need for speeding up automation of systems, instruments and technological processes, crucially dependent on introduction of computers and particularly microprocessors by educated and skilled personnel. He also emphasized cooperation between regional societies as well as with societies in other countries such as the GDR, essential to meeting those goals. Deputy USSR Minister of Communication Yu. B. Zubarev reported on the use of YeS "Unified System" computers and SM "International System" small computers in scientific research institutions as well as in industrial enterprises. Deputy USSR Minister of Instrumentation, Automation and Control Systems Yu. V. Tolstykh and Deputy Chief of Main Scientific-Technical Management at the Ministry of Communication Industry S. M. Kudryavtsev reported on automation and microprocessorization of postal service, long-distance and local telephone networks, also printed mass media, with attendant increase and improvement of services accompanied by better cost effectiveness especially in terms of labor saving. Their reports also covered developments in radio measurements, telephone and telegraph technologies, also joint projects with corresponding UkSSR ministries and institutions programmed for the 1983-90 period. The session concluded with passage of resolutions and establishment of guidelines in regard to further work on automation, computer and microprocessor development, including both hardware and software, allocation of resources, management at the various administrative levels (republics, krays, oblasts, municipalities) within the scope of overall planning for the national economy. [247-2415]

PRODUCTIVITY OF MICROPROCESSOR EQUIPMENT INTERFACING CONTROL SYSTEM OF QUASI-ELECTRONIC AUTOMATIC LONG-DISTANCE TELEPHONE EXCHANGE WITH TERMINALS

LIPETS, A. M.

[Abstract] Microprocessor interfacing of the control system in a quasi-electronic automatic long-distance telephone exchange with the terminals is analyzed on the mathematical basis of the M/G/1 queuing model with a single attendant device, assuming a Poisson distribution of the message flux and a gamma distribution of the attendance time. A formal analysis of the control and interfacing algorithm, including operation of the LSI series K580IK51 microprocessor components and of the terminal adapters, with the aid of a code converter and a program-transfer address lookup table, indicates ways to improve the productivity of this microprocessor equipment in terms of minimizing the mean message attendance time, by better economy of hardware involvement in accordance with an only slightly modified algorithm, by elimination of nonessential functions, and by optimizing the hookup of terminals. Figures 4; references 4: 3 Russian, 1 Western (in Russian translation).
[247-2415]

PRINCIPLES OF DESIGNING TELEPHONE NETWORKS WITH SEVERAL AUTOMATIC INTERZONAL EXCHANGES IN ONE ZONE

IL'INA, L. D., PROKOF'YEVA, G. I. and SOLDATOVA, Ye. A.

[Abstract] The design of zonal telephone networks is analyzed from the standpoint of optimizing them as well as contiguous interzonal ones, which requires installation of several automatic interzonal exchanges within one urban zone or district center so as to match demographic patterns and avoid congestion of interzonal channels. Technical and economic considerations enter here, inasmuch as every automatic exchange becomes a part of both zonal and interzonal networks at the same time. Basic principles of design and siting are established first for an interzonal network with either one or several automatic exchanges respectively and subsequently for a zonal network with several automatic exchanges. These principles are applied to the three possible variants of zonal network layout with several systemal automatic exchanges in one city and the two possible variants of zonal network layout with several systemal and nonsystemal automatic exchanges in one city, also to assurance of compatible operation of automatic exchanges installed at various points within a zone. Next are considered interconnection of systemal automatic exchanges as well as interconnection of systemal and nonsystemal automatic exchanges.

These interconnections are necessarily different for ARM (ARE) and quasi-electronic automatic interzonal exchanges. Figures 6, references: 1 Russian. [247-2415]

RESULTS OF STUDY CONCERNING LOADS ON AND CALLS FOR SPECIAL SERVICES IN URBAN TELEPHONE NETWORK

MOREV, V. L., BORETSKIY, B. I., IOFFE, I. Z., MANUYLOVA, R. K., MOROZ, A. L. and PUKHOV, N. A.

[Abstract] A study of special services in the Leningrad Metropolitan Telephone System was made for the purpose of determining the daily load curves and the growth of demand for such services over the 1970-83 period. The data have been subsequently organized to cover the conventional four emergency services, long-distance calls, information service, and time information, also the additional services introduced over the 1970-79 period. The latter services, some handled by operators and paid for, others handled automatically and free, include directory assistance, weather report and weather forecast, lottery information, arts and entertainment information, travel and tourist information, Aeroflot information, societal and political news, court proceedings, transmittal of telegrams, sales information, "dial a joke" and "dial a children's story". The results provide a sound basis for management of these services and rate setting. Figures 4; tables 2; references: 3 Russian. [247-2415]

WAYS TO REDUCE LABOR IN MAINTENANCE OF TEN-STEP AUTOMATIC TELEPHONE EXCHANGE

LOGINOVA, O. A. and MAVRINSKAYA, E. R.

[Abstract] A few ways to reduce the labor in maintenance of 10-step automatic telephone exchanges are proposed, the principal among them being pullback from around-the-clock operation and consequent reduction of fire hazard in the not highly reliable low-resistance selector electromagnets. Two versions of a device for disconnecting selector racks have been developed and built, considering that GI and LI selector electromagnets are controlled differently than preselector electromagnets. The UOS-GI/LI disconnector operates with station-wide ± 1 min time delay and is triggered by rack signalization, while the UOS-PI disconnector in parallel with the electromagnet supply circuit is triggered by a separate pulse pair. As a subsequent labor saving measure, preventive

inspection is scheduled for the night shift and, moreover, done with auto-
matically operating instruments. Eleven 10-step automatic exchanges have
been changed over thus and, as a result, 14 units of operating staff released
for other duties. Tables 1.
[247-2415]

ARV-MTS EQUIPMENT FOR AUTOMATIC DISTRIBUTION OF LONG-DISTANCE CALLS

BEREZOVICH, L. A., IVASHEVSKIY, V. G. and SVIRIDOVA, G. P.

[Abstract] New equipment for automatic distribution of long-distance calls
has been developed at the Sverdlovsk branch of the Special Design Office which
facilitates the switching of call circuits. The technical and economic
indicators of this ARV-MTS equipment are better than those of existing MTS-MRU
equipment, inasmuch as calls are swept uniformly among 20 switchboard operators
and picked up by the first free operator without use of plugs or switches and
the queuing time is thus appreciably shortened. A call can be transferred to
the information desk or directly to the supervisor's desk, an interlock pre-
vents hookup of two or more operators to the same line, customer billing and
operator monitoring procedures are improved, and interservice communication
between operators or with the supervisor is made possible. The customer does
not wait so long for an operator's response and, in the case of relatively few
variable routes, special switchboard can be organized with fewer operators.
The equipment consists of a rack with distributor stages and check markers,
two chassis and two panels, mounted call circuit module and input terminal set,
a set of call switching commutators, a supervisor's desk, and an operator
monitoring commutator for service quality control. The equipment is designed
for operation with KZL call circuits and alongside existing MTS-MRU equipment
with gradual transfer. Its total weight is under 400 kg, it draws not more
than 7.8 A from the 60 V d.c. station battery and not more than 2.2 A from the
24 V d.c. station battery. Installation of the experimental specimen of this
equipment and its use for a trial period have improved the productivity of
telephone operators by 18-20% and reduced the mean access time for long-
distance calls from 34.4 to 28 s. Figures 2; tables 1.
[247-2415]

RECONSTRUCTION OF TRUNKS WITH CHANGE FROM K-300 TO BK-960-2 TRANSMISSION SYSTEM

VORONOV, A. D. and PINSKIY, I. M.

[Abstract] Communication trunks are being reconstructed for the purpose of
lengthening the channels and improving the quality as well as the reliability

of data transmission in every mode most economically, with reduction of operating costs as an important spinoff. An essential item in this reconstruction is replacement of K-300 with BK-960-2 transmission equipment, the latter being produced in the Hungarian Peoples Republic. The reconstruction process has been scheduled to occur in five steps. Preparatory operations include mounting unattended repeater station equipment on special pads with grounding wires, jumpers and cords. Subsequent preliminary operations include connecting Pupin coils, which is done with the mobile power supply channel and the telemechanics shut down. There follows installation of BK-960-2 equipment in unattended repeater stations, up to 50 between two attended ones, in three stages: first insertion into the trunk without amplifier modules, then connection of amplifier, and finally withdrawal of K-300 equipment and alignment of cable with the aid of prepared jumpers. The new transmission system is put in operation, after all BK-960-2 equipment including BK-960-2 telemechanics has been checked and tuned. Figures 3; references: 3 Russian. [247-2415]

DIGITAL CODECS WITH DELTA-SIGMA MODULATION

BRUNCHENKO, A. V.

[Abstract] Digital codecs are described, such codecs being preferable to analog ones because of their adaptability to large-scale integration. The encoder part consists of an analog modulator at the input which generates a delta-sigma modulated digital signal with time discretization frequency f_{s1}, a decimator which converts this signal into a linear pulse-code modulated one with discretization frequency $f_g << f_{s1}$, and a nonlinear modulator which compresses the digital code by decreasing its length. The special feature here is the delta-sigma modulator, in which an analog subtractor with an output filter is followed by a threshold device and the latter by a clocking time discretizer. The threshold device and the time discretizer can be combined into a D-trigger, putting out the modulated digital signal with feedback to the analog subtractor. The decimator is a low-pass filter which eliminates noise in the $f_g - 1/2f_{s1}$ range so as to keep such a noise out of the useful signal after the discretization frequency has been decreased. The filter can be a uniform nonrecursive one of length equal to f_{s1}/f_g, or a triangular of length f_{s1}/f_d, or a triangular one of length $2f_{s1}/f_g$. The analog input signal is assumed to be contained within a finite frequency range. The decoder part consists of a nonlinear demodulator which expands the digital code, a zeroth-order or first-order interpolator acting as a digital filter which increases the time discretization frequency from f_g to f_{s2}, and a digital delta-sigma modulator or multilevel modulator based on an integrating circuit. The digital-to-analog converter at the output consists of a low-pass filter with

an upper cutoff frequency equal to the upper edge of the analog input signal. An important performance indicator of such codecs is the noise level, which is calculated here with the aid of Z-transformation on the basis of a linear model of delta-sigma modulators and assuming uncorrelated noise and signal with the former uniformly distributed over the $0-f_{sl}$ range. Figures 7; tables 2; references 8: 3 Russian, 5 Western (2 in Russian translation).
[247-2415]

PROGRAM OF ACTIVITIES ON APPLICATION OF MICROPROCESSOR TECHNIQUES

MONINA, G.

[Abstract] A report on an all-round program of activities pertaining to automation of communication facilities and application of microprocessor techniques over the rest of this decade and the entire next decade was presented to the Scientific and Technical Council at the USSR Ministry of Communication. The report dealt with the activities of educational and research institutions, design planning organizations, and communication enterprises. These activities are to cover the use of microcomputers for solution of problems, quality control of communication equipment in automatic long-distance exchanges and in urban telephone networks, as well as in television networks, for information service, for postal service, for telegraph service, for billing and accounting in the hotel industry, and for management of the Unified Automatic USSR Communication System. Following the report, the Scientific and Technical Council approved the main guidelines for these activities and adopted a few recommendations for extensive application of the "controlling computer collective" theory so as to facilitate distributed processing as well as introduction of paperless technology.
[247-2415]

COMBINATIONAL CALCULATOR-BASED SYNTHESIZER OF SIGNALS WITH LINEAR FREQUENCY MODULATION

KOCHEMASOV, V. N. and REVUN, A. D.

[Abstract] A synthesizer of signals with linear frequency modulation is described which operates on the basis of automatic pulse phase tuning with a fractional frequency divisor. The resulting larger bandwidth of the synthesizer ring makes it possible to raise the operating frequency of the pulse phase detector and consequently decrease the dynamic errors and increase the frequency resolution as well as the modulation rate. The synthesizer consists

of a controlled oscillator with modulator, a pulse phase detector with filter, an oscillator-detector synchronizer, a pulse shaper, and a digital pulse converter. The pulse converter includes a pulse eliminator, a variable-divisor frequency divider, a delay line, a code divider, a code storage, and a control module. Phase deviations from the desirable square-law function of time and errors of phase measurements by the detector are related through a code of phasal divisibility errors and can be compensated, which is done here by the code-controlled delay line. Such a 6-position synthesizer has been designed and built for the 16-22 MHz frequency range with a maximum linear-frequency-

modulation base of (6 MHz) (12ms) = $72 \cdot 10^3$. It was tested and its performance evaluated on the basis of oscillograms. Figures 4; references 5: 4 Russian, 1 Western.
[247-2415]

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ADAPTIVE CORRECTION ALGORITHMS FOR TIME POSITION OF PULSES IN QUASI-PERIODIC SEQUENCES

SEDLETSKIY, G. L.

[Abstract] In digital synthesizers with 2-level pulse sequences it is sometimes preferable to use a controlled delay line with taps instead of a frequency divider for correction of phase errors. Such a delay line is controlled in real time, its algorithm depending entirely on both synthesis and structure of the pulse sequence. With the pulse deviation pattern usually unknown and often very intricate, an adaptive rather than determinate algorithm of pulse position correction is needed. Such algorithms can be constructed on the basis of a rigorous redefinition of pulse sequence in terms of subdivision into pulse groups forming quasi-periodic sequences, each characterized by a mean period and by a base equal to the number of pulses it contains as well as maximum and minimum pulse repetition periods. The basic algorithm of pulse position or phase correction must ensure retention of similarity in terms of base and convergence with respect to conversion frequency after the transient process between input quasi-periodic sequence and output quasi-periodic sequence. It must also be universal, suitable for any quasi-periodic sequence with given four parameters t_{max} and t_{min} (maximum and minimum time intervals between successive pulses), τ (pulse duration), $t_i^{(T)}$ (time interval between successive pulses in uncorrected input sequence) as necessary and sufficient information, and it must be efficient in terms of a much larger than unity ratio of input sequence nonuniformity to output sequence nonuniformity. The algorithm $\Delta t_i = K(S - t_i^{(T)} + \Delta t_{i-1})$ (Δt_i - delay time of i-th pulse, Δt_{i-1} - delay time of (i-1)th pulse, $0 < K < 1$ - constant coefficient, $\Delta t_{max} \leq S < \infty$ - constant coefficient) satisfies all these requirements, as can be demonstrated by

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rigorous proof. Increasing its efficiency by increasing K will also increase the time delay, which is undesirable, and shortening the latter without degrading the correction requires an appropriate transformation of the algorithm such as $\Delta t_i = K(t_{max}^{(T)} - t_i^{(T)} + \Delta t_{i-1})$. Figures 3; references 3: 2 Russian, 1 Western (in Russian translation).
[247-2415]

CONVERGENCE OF TUNING ALGORITHM FOR ADAPTIVE SIGNAL CORRECTION DEVICES

LAZAREV, A. M. and SHEVCHENKO, Yu. V.

[Abstract] The discrete pseudogradiental algorithm for tuning an adpative signal corrector is analyzed for convergence in the probabilistic sense, considering that a data signal at the output of a band-limited communication channel is expressible in an analytical form regardless of the type of modulation. The expression includes cophasal and quadrature components of the response and of the additive "white" noise, both response and noise thus being represented as complex quantities, with a complex transmission coefficient independent of the frequency. With the rms error regarded as criterion of convergence and thus also of corrector performance, the optimizing vector is sought which will minimize that error. This is done by applying the concept of convergence in the rms sense to the tuning vector and to the optimizing vector, both vectors being random ones, as basis for analysis and solution of the corresponding stochastic difference equation. The equation is eventually reduced to a ratio of error decrement to prior error, this ratio being a nonlinear function of the prior error. On this basis can be established first the convergence range for the algorithm and then the stability range for the adaptive converter, the latter not only as a function of corrector parameters but also as a function of initial signal distortions and of channel noise. The tuning problem, including determination of the "true" stability point and the limiting point, has been solved by simulation on a YeS-1022 digital computer for a 4800/9600 bit/s tone-frequency channel with 2/4-level single-sideband modulation. Figures 1; tables 2; references 9: 4 Russian, 5 Western.
[232-2415]

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RADIO CALL-IN SYSTEM WITH TRANSMISSION OF MESSAGES

BUKHVINER, V. Ye.

[Abstract] A radio call-in system is described which ties into a radio broadcast network and includes transmission of messages. It is designed with most economical voice-to-digital signal conversion by the compacting method so as not to exceed its storage capacity. In the basic mode it operates during radio braodcast intermissions. The number of callers it can serve is proportional to that storage capacity (YeS-5060 storage 1 Mbyte, YeS-5056 storage 10 Mbyte, YeS-5051 storage 100 Mbyte), but inversely proportional to the message length t and to the recording speed F. With a YeS-5051 storage, t = 1 min and F = 4.8 kbaud, and an α = 10 factor characterizing the reutilization of recording segments, it can serve 30,000 callers. The access time is 0.3 s. It can also operate during radio broadcasts, at lower capacity, if multiplexing techniques are used.
[232-2415]

OPTIMIZATION OF DYNAMIC RANGE OF RADIO RECEIVER WITH RESPECT TO THIRD-ORDER INTERMODULATION

LEDOVSKAYA, V. I. and SHUL'GIN, V. F.

[Abstract] The problem of third-order intermodulation in radio receivers is considered and, for optimization of the dynamic range from this standpoint, an analytical expression is derived which describes the dependence of the dynamic range on the relevant parameters of successive receiver stages. A relation is subsequently established between the dynamic range and the sensitivity of a radio receiver. Design guidelines are given, supported with numerical data, on selection of channel and stage parameters ensuring the maximum dynamic range and the minimum loss of sensitivity. Since an increase of the matching factor reduces the sensitivity, it is limited by the maximum permissible loss of sensitivity of the first stage. Calculations have been made for receivers with n = 2,3,4 stages respectively. Figures 1; tables 1; references 5 Russian.
[232-2415]

MONITORING OF ERRORS IN COMMUNICATION SYSTEMS WITH SPACE-TIME DIVISION OF CHANNELS

SHESTAKOV, V. V.

[Abstract] A device has been developed for measuring the fidelity of data transmission by pulse packets in multiple-access intercomputer data exchange systems with space-time division of channels. The device consists on one end of a test-signal transmitter (generator of $2^{10}-1$ long m-sequence + preamble generator) which feeds an 80-bit meander + a 7-bit 7-position Barker code + a 1-bit phase starter + a 1023-bit pseudorandom sequence into a discrete channel. On the receiver end the device consists of a clock generator with phase-lock automatic frequency control, a standard-sequence generator, a trigger which initiates a measurement cycle and actuates a 1023-bit sequential array of counters, followed by an error detector with a circuit for pickup of once occurring errors and a circuit for pickup of twice occurring errors as well as an overflow circuit for indication of errors occurring more than twice within an 8-bit interval. An array of output counters feeds error data in the form of two bytes to a microcomputer for processing and printout. The error monitor and the microcomputer are matched and interfaced through control counters and a coincidence circuit, triggers and OR logic. The device, suitable for communication systems operating with 5 Mbit/s data pulse packets, has been built with series 155 integrated microcircuits. Figures 1; references 7: 3 Russian, 4 Western.
[232-2415]

ADAPTIVE MATRIX CORRECTION IN FREQUENCY DOMAIN

ZOTKIN, V. B. and KOROBKOV, D. L.

[Abstract] Adaptive correction is considered for suppression of intersymbol interference resulting from linear signal distortions. The corrector at the channel output is designed to minimize the rms transmission error. A conventional transversal filter does this by convolution. For optimizing the process, a matrix filter with blockwise transmission and correction is proposed instead. Correction by such a filter is done in the frequency domain and must therefore be preceded by a discrete Fourier transformation and followed by an inverse discrete Fourier transformation of the control vector. Such a matrix filter combined with a one-dimensional Kalman-Bjusey filter improves the algorithm of correction, namely its efficiency and convergence, without increasing its complexity. Figures 1; references 5: 2 Russian, 3 Western (2 in Russian translation)
[232-2415]

FAST NONITERATIVE TUNING OF MATRIX CORRECTOR IN FREQUENCY DOMAIN

ANDZHEYCHAK, B.

[Abstract] Digital matrix correction in the frequency domain is considered for complete suppression of intersymbol interference, and a fast noniterative algorithm with minimum mathematical complexity is constructed for tuning such a corrector. The four steps of this algorithm are: generate a unit-impulse test signal--average the response readings--discrete Fourier transformation of the vector of readings after the latter has been completed with zeros to full dimensionality--calculate the elements of the diagonal corrector matrix. Both efficiency and convergence of this algorithm are evaluated, assuming the presence of an additive narrow-band Gaussian noise with zero mathematical expectation and a dispersion equal to its mean power in the transmission channel. Figures 3; references: 2 Russian.
[232-2415]

MAXIMUM ATTAINABLE EFFICIENCY OF CODING UNDER GIVEN DISTORTION LEVEL

SENDERSKIY, V. A.

[Abstract] A communication channel with given mean signal power and spectral density of normal white fluctuation noise is considered for transmission of binary data in minimum time without lower than given probability of correct reception. The maximum interference immunity of such a channel, characterized by the lower limit of the signal-to-noise ratio, is evaluated on the basis of Shannon's coding theorem and its application to a discrete source with the corresponding accuracy criterion. It is first evaluated for the general case, without restrictions on the coding method, and to an ideal coding. It is then evaluated for multiposition coding with equidistant signals or with orthogonal signals, coding with orthogonal signals being found to be asymptotically optimal with respect to energy advantage.
[232-2415]

GENERAL INFORMATION ABOUT QUASI-ELECTRONIC TELEPHONE EXCHANGES

LOCHMELIS, Ya. Ya., docent, Riga Polytechnic Institute

[Abstract] An overview of quasi-electronic automatic telephone exchanges is presented, with particular relevance to the "Kvant" type recently introduced to railroad communication networks. In addition to meeting all modern performance and reliability requirements, they must be built with mass-producible components and a high degree of standardization, designed for automation of services and automation of maintenance. A comparative evaluation of quasi-electronic and electromechanical automatic exchanges reveals the tremendous advantage of the former, namely feasibility of program control and common signalization channels, of additional services, and of automated equipment inspection including fault location and selective cutout. While also smaller in size and containing less metal than electromechanical automatic exchanges, quasi-electronic ones require more power supply and electric energy. This drawback needs to be and is being overcome by maximizing and optimizing the conversion to semiconductor and other miniature solid-state devices. Quasi-electronic automatic exchanges differ in construction of the switching system and the control module, in size (small ones for up to 200 customers, medium ones for 200-4000 customers, large ones for over 4000 customers) with a telephone number counted as a customer, and in application. One thus distinguishes urban (district), rural (central, junction, terminal), institutional-industrial, and zonal (long-distance) automatic exchanges. The core of every quasi-electronic one is a control computer with direct-access memory, read-only memory, programmable read-only memory, arithmetic-logic unit, and control unit. Switching panels constitute the peripheral equipment interfaced with the computer through low-speed/high-speed matching peripheral control devices. The rest is terminal equipment and connecting lines. Figures 5.
[231-2415]

'TRANSPORT-SRS' RADIO COMMUNICATION SYSTEM FOR RAILROAD STATIONS: BASIC TECHNICAL REQUIREMENTS

VAVANOV, Yu. V., candidate of technical sciences, department head, All-Union Scientific Research Institute of Railroad Transportation Engineers, ZYKOV, V.I., candidate of technical sciences, and RAGOZINA, L. V., chief engineer

[Abstract] The station radio communication systems "Transport-SRS" now developed for railroads must feature high-quality channels reliably operating under high levels of pulse interference, a large number of channels to be made available by effective utilization of the electromagnetic spectrum and adequate electromagnetic compatibility. In addition, the system must be easily

accessible to its users and convenient to handle, contain reliable equipment and be automatically controllable. Its main function will be to facilitate shifting of trains, for which it must establish connections between the locomotive engineer's cabin, semafors and speed regulators, the station, and the shunt yard while the locomotive moves through various zones during a maneuver. This requires a multichannel mobile transceiver in the locomotive, with the optimum number of operating frequencies as determined by specific conditions and other uses of the communication system. These other functions include aiding technical and commercial inspection of rolling stock, inventory, loading and unloading, signalization-centralization-interlocking, and civil defense. The minimum separation between channels should be 25 kHz. Design calculations are aided by a "Minsk-32" computer, a special algorithm for frequency assignment having yielded a very satisfactory scheme of seven frequency series with two groups of six different frequencies in each. The problem of electromagnetic compatibility can be subsequently solved on the basis of such a scheme. Figures 2; tables 2.
[231-2415]

OPERATION OF POWER SUPPLIES IN TYUL'PAN AND DNEPR RADIO STATIONS

LAPTEV, L. K., senior engineer, Main Administration of Industrial Railroad Transportation, Ministry of Railroads and PICHUGIN, B. N., senior electro-mechanic, Klin Industrial Railroad Transportation Enterprise

[Abstract] Tyul'pan and Dnepr portable radio stations use power supplies consisting of six TsNK-0.45-I-U2 or TsNK-0.45-II-U2 nominally 7.5 V storage batteries each. A fully charged battery can operate 8 h continuously with the receiver for 7.5 h and with the transmitter for 0.5 h, or 12 h continuously with the receiver for 9.25 h and with the transmitter for 2.75 h. In order to ensure such a performance, it is necessary to recharge the batteries afterwards to 7.9-8.1 V according to a controlled schedule. The required charge time depends on the voltage level and ranges from 7 h when the voltage has dropped to 7.0 V to 15 h when it has dropped to 6.2 V. Within a few hours after recharge the voltage will drop to and stabilize at 7.4-7.6 V. If it drops lower, the battery is defective and needs to be overhauled. All batteries must be once a year tested for their ability to undergo 25 charge-recharge cycles. After such a test each battery is disassembled, checked, cleaned, repaired (if necessary), and reassembled for further operation. In cold weather, when a healthy battery loses capacity upon freezing and recovers fully upon thawing, both overcharging and undercharging shorten the battery life. A battery must never be drained below 6 V. Battery operation must be monitored and logged all year round, its charge-discharge cycles to be counted and recorded every month. The life expectancy of these batteries is 3 years, with noise suppression and temperature control. Figures 3.
[231-2415]

COMPENSATION OF REACTIVE POWER IN 50 Hz RAIL CODE CIRCUITS

ZHUL'KOV, V. F., chief engineer, signalization and communication service, Moscow railroad line, and USHAKOV, V. F., senior instructor, Yaroslavl branch, All-Union Correspondence Institute of Railroad Transportation Engineers

[Abstract] Locomotive signalization systems require a minimum current of 2 A at the relay end of rails feeding the d.c. electric traction set. The 50 Hz rail code circuits draw reactive power, which is now compensated by means of 24 µF capacitor banks across the transformrer secondary at the supply end. This is not adequate, inasmuch as it does not take into account the inductance of the supply transformer-choke. A comprehensive program has been devised for computer-aided design and performance analysis of rail code circuits along the entire Northern railroad line, with insulation resistance included and with service conditions taken into account. Calculations of voltages and currents, active and reactive power, have been programmed for an SM-1 small computer and a YeS-1022 computer. The results pertaining specifically to a POBS-3A power supply indicate the optimum compensating capacitance on the basis of a 1 ohm·km insulation resistance. This capacitance is appreciably higher than 24 µF, depends inversely on the length of the rail code circuit, and is appreciably higher when calculated for normal load and short circuit than when calculated for normal load only. In the first case it ranges from 68 µF for a 0.5 km long circuit to 52 µF for 1.5-2.5 km long circuits. In the second case it ranges from 48 µF for a 0.5 km long circuit to 40 µF for 1.5-2.5 km long circuits. Figures ; tables 4.
[231-2415]

AUTOMATIC INSTRUMENT FOR MEASUREMENT OF DISTORTIONS IN TELEGRAPH SIGNALS

Staff writer

[Abstract] An automatic instrument for measuring distortions in telegraph signals in accordance with CCITT norms has been developed and built by Senior Electromechanic A. A. Kublitskiy and Electromechanic O. D. Zayezzhay at the Konotop track section of the South-West railroad line. It consists of an input device, a time relay, a 16-position start-stop distributor, a meter of 0-50% negative deviations, a meter of 0-50% positive deviations, an 8-position text distributor with code conversion, a transmitting distributor with starting circuit, an electronic output relay, a clock-pulse generator, and a power supply. The time relay monitors operation of the telegraph at a terminal point, controlling the end of measurement cycles and transmittal of results to the terminal point. The start-stop distributor generates pulses which correspond to characteristic moments of modulation of ideal telegraph pulse packets and

sets the distortion measurement limits. The distortion meters contain each a control circuit, a duo-decade binary-decimal counter up to 50, a memory register, and a code comparator. The text distributor converts readings in the binary-decimal code into equivalents in the ITC-2 code. The transmitting distributor converts symbols in the ITC-2 code from parallel to sequential at a telegraphing rate of 50 baud, and the output relay shifts to text distributor accordingly. The entire instrument is built with series 155 integrated microcircuit chips and mounted on a plug-in printed-circuit board, in parallel with a standard IKI-ST instrument on an APSK meter table. It has been operating successfully for more than 3 years in the Konotop track section, saving over 3,000 rubles annually in operation costs. Figures 3; tables 1. [231-2415]

FURTHER DEVELOPMENT OF RURAL COMMUNICATION

Moscow VESTNIK SVYAZI in Russian No 2, Feb 85 pp 2-4

SHAMSHIN, V. A., USSR Minister of Communication

[Abstract] Improvement and further development of rural communication systems, particularly telephonization of the farm lands, are part of an overall agricultural reform program aimed at increasing output and efficiency, according to a long-range overall plan which took effect in 1982 and will run till the year 2000. Telephone communication plays an essential role in this overall plan, especially "intercom" systems in agricultural enterprises such as sovkhozes. The number of residential rural telephone subscribers also needs to be raised to a decent level, from the present 2 million only (46.4% of all rural subscribers and less than 10% of all rural residents). This dire situation is aggravated by projections indicating that the rural population will double by the year 2000. Communication experts of All-Union organizations will need to cooperate with those of organizations under the jurisdiction of individual republics. While the major emphasis is on telephone, attention must and will be paid also to rural television and radio communication as well as postal service. Developments in all modes of individual and mass communication will require participation of an all-out effort by the equipment manufacturing enterprises, inasmuch as availability of hardware is of overriding importance here. Telephonization of Soviet farm lands should be much easier than their motorization, since it does not require paved roads and highways. A report on implementation of the program and its various aspects was presented to the CPSU Central Committee at its regular plenary session in October 1984 by Comrade K. U. Chernenko and Comrade N. A. Tikhonov. [236-2415]

EXPANDING RURAL LONG-DISTANCE COMMUNICATION SERVICES

GERCHIKOV, Ye. Ya., communications expert, and STAROSTIN, L. Ya., chief, Vinnitsa office of communications production-engineering management

[Abstract] Services for rural subscribers in the Vinnitsa regional long-distance telephone network are being expanded by a general discontinuation of parallel hookup and by installation of outdoor public booths with coin change and token boxes as well with all toll information posted. These booth remain open during all hours of day and night, thus also when public communication offices are closed. Noteworthy are the initiatives taken and efforts made in this project by the communication workers' collective at the Tul'chin regional communication center. This collective has helped organize expansion of services in several villages, Sokolets and Pechera most outstanding among them. Such an expansion of services parallels expansion of the long-distance network to more villages and thus to a wider population, neither expansion nor improvement being nearly complete yet. Figures 1.
[236-2415]

IMPROVING EFFECTIVENESS OF RURAL WIRE BROADCASTING

BELYAYEV, A. I., deputy chief, Tul'sk office of communications production-engineering management

[Abstract] Effectiveness of wire broadcasting in the Tula Oblast is being systematically improved, especially in the area of rural "radiofication" where the task is most difficult. The problem is both technical and economic, most importantly efficient utilization of personnel and labor along with gradual automation of control and inspection. A changeover to remote control of ultra-short-wave FM channels in two radio stations, Tula and Novomoskovsk, was begun in 1975 and completed in 1976. Today there are 131 radio rediffusion stations in the Tula Oblast, 104 of them remote-controlled and attended by a single electromechanic or electrician. Automation has eliminated broadcast interruptions, but installation of TUPV-0.25x2 and TUPV-0.5x2 transistorized wire-broadcasting equipment has created a need for highly skilled maintenance personnel. This personnel and the workshops in Novomoskovsk, Aleksin, Shchekino districts have been organized so well that most of their time is available for preventive maintenance and development activity. The major achievements so far are reduction of the cable length by better layout and addition of radio receivers (loudspeakers) to an average total of 49.1 per km, there were only 24 per km before, without expenditure of extra amplifier power per receiver set. Development of new radio rediffusion stations has already been carried to the prototype testing and pilot operation stage. Analysis and evaluation of performance data indicate a steady overall improvement in the state of line "radiofication" management, on the basis of periodic measurements and monitoring. Development of automatic telephone answering devices for daily quality control

of rural radio network performance is now underway, 115-rediffusion stations
being already equipped for this purpose. Equipment specifications are already
documented in the applicable "Standard", service problems are reviewed
quarterly, and a sound procedure for fault detection and fault clearance is in
force. Figures 1.
[236-2415]

MULTIPLEXING CABLES OF FEW ALUMINUM-COPPER CONDUCTOR PAIRS WITH V-2-2 TRANSMISSION SYSTEMS

PARFENOV, Yu. A., candidate of technical sciences, and NEFEDOVA, D. V.,
senior engineer, Leningrad Department, Scientific Research Institute of
Communication, SULTAN-ZADE, E. V., chief engineer, Central Scientific Research
Institute of Communication, CHERVYAKOV, L. S., engineer, and IL'IN, V. V.,
engineer

[Abstract] A cable with only a few aluminum-copper conductor pairs and water-
repellant filler for rural telephone networks has been developed jointly by
the Central Scientific Research Institute of Communication (Leningrad
Department) and the cable industry. This now commercially produced TSPZP
5x2x0.9 cable contains five twisted pairs of bimetal conductors 0.9 mm in
diameter around a water-repellant core, with solid polyethylene insulation and
aluminum ribbon shield inside a polyethylene jacket. A modification of this
cable with additional armor is available for protection against rodents. Its
electrical characteristics, satisfactory for low-frequency (800 Hz) communica-
tion over distances up to 6.0 km long, allow multiplexing it with V-2-2 trans-
mission systems originally designed for overhead installation. This is pos-
sible because the electrical characteristics of the cable over the 0-30 kHz
frequency range are compatible with those of 2-channel 2-band (4.63-12.7 kHz
and 17.63-25.7 kHz) transmission systems with frequency division of channels.
With such a multiplexing of a TSPZP 5x2x0.9 cable, it becomes feasible to lay
up to 10 telephone lines up to 14.5 km long without repeaters or up to 25 km
long with one unattended repeater station. Tables 1.
[236-2415]

REDUCE PRODUCTION COST

KHEKKER, G. I., chief, Department of Planning and Finances, "Order of Lenin"
Central Telegraph Office, USSR Ministry of Communication

[Abstract] Along with increasing the labor productivity, reducing the produc-
tion cost is a major goal pursued by the USSR Ministry of Communication and,
specifically, by the financial planners at the Central Telegraph Office. These
goals are being achieved by development and introduction of new devices such

as the "Interval" electronic adapter, by conversion from single channels to multichannel systems, and at the same time more economic utilization of personnel and equipment through expansion of services and addition of new ones. The underlying principle here is that more and better services will increase the demand for them and thus reduce the unit cost of providing them. Other factors contributing to the cost reduction are a precise accounting procedure on a plant-by-plant basis with continuous performance control and limit setting, rigorous implementation of energy and material saving techniques, and an incentives policy of personnel management. While goals are being achieved, the task is not completed yet and more improvements in planning as well as in implementation are sought.
[236-2415]

METROLOGICAL SERVICE

KUZNETSOVA, T. S., chief engineer, Kiev Central Telegraph Office, and SHMATKOVA, N. V., chief, Operations and Engineering Department

[Abstract] A metrological service has been set up at the Kiev Central Telegraph Office, for the purpose of improving and controlling the quality of performance. The functions of this service are inspecting, repairing, checking, and utilizing all instruments in accordance with governing standards, rules, and norms. The service is headed by a chief telegraph metrologist and a senior engineer, with one radio engineer and two electrical engineers responsible for the instruments in their respective areas. Two specialists trained at the All-Union Institute for Improving the Qualifications of Managing Engineers and Technicians in Standardization, Production Quality and Metrology have the authority to inspect all instruments department-wide, more than 1000 instruments being used at the Kiev Central Telegraph Office alone. Since this service has been on duty, the percentage of telegrams delivered on time has increased from 97.2% in 1983 to 97.9% in 1984 and the percentage of connection failures in the switching network has decreased from 2.5% to 2.2% in the same period.
[236-2415]

ANALYSIS OF PERFORMANCE IN TERMS OF ERROR PROBABILITY OF MODEM WITH DIGITAL PROCESSING OF SIGNALS AND MINIMUM FREQUENCY-SHIFT KEYING

[Abstract] Signals with minimum frequency manipulations are promising for use in data transmission systems. Because of this in a number of cases radio stations with amplitude modulation, set aside also for transmission of speech communications, are suitable. Such radio stations use minimum frequency-shift

keying at a subcarrier frequency, and processing of information in a regime of data transmission, is conducted by modems fulfilled in individual blocks. The probability of error in the system is calculated for various values of the bandwidth of the linear section of the receiver. Figures 4; references: 5 Russian.
[202-6415]

POTENTIAL PERFORMANCE IN TERMS OF ERROR PROBABILITY OF PARALLEL DATA TRANSMISSION BASED ON WALSH FUNCTIONS, BY MEANS OF CHANNEL WITH SHORT-TIME INTERRUPTIONS

KIRILLIN, A. N.

[Abstract] Methods for prevention of short-time interruptions in communication channels are based on the use of Walsh functions as information "carriers." The essence of these methods consists of the simultaneous transition of N message elements, during which a group signal transmitted by the communication channels is formed by means of a summation of N Walsh functions $\varphi_i(t)$ (i = 1, 2,...,N) with weight functions α_i. An evaluation is made of the potential performance in terms of error probability of the above method of transmission with optional laws of distribution of the duration of intervals and the pause between them. Figures 1; references: 4 Russian.
[202-6415]

CONCERNING FACTORABILITY OF SPACE-TIME PROCESSING OF WIDE-BAND SIGNALS

DANILEVSKIY, L. N., KOROBKA, O. V., and LYUTAREVICH, B. L.

[Abstract] The condition is stated for factorability of space-time processing of signals as applied to problems of suppression of wide-band interference signals, taking into consideration the required degree of suppression. It is shown that for a high degree of suppression, the condition indicated coincides with the traditional condition of factorability of space-time processing of signals. During processing of signals in antenna arrays of complex configuration, the wide-band properties of the signals are more significantly displayed in the cross section of an antenna which has the greatest dimensions. From this point of view linear antenna arrays are a convenient model for an approximate evaluation of the wide-band properties of an antenna of more complex

form. Thus, use of these proposed criteria for the factorability of processing output signals, taking account of the required suppression, can prove to be useful during the solution of practical problems of apparatus construction. References 3: 2 Russian, 1 Western.
[202-6415]

SPECTRAL CHARACTERISTICS OF CLASS OF SYSTEMS OF ORTHOGONAL DISCRETE FUNCTIONS

TITOV, A. V.

[Abstract] A rule is established for constructing a class of systems of orthogonal functions for any $N - 1$ and not just Walsh functions with $N = 2^n$ (N - length of sequences, n - positive integer). This rule, based on the fact that the length of sequences N determines the number of discrete functions forming an orthogonal system, is expressed in the form of an NxN-dimensional square matrix. For even N this rule is equivalent to the rule for constructing Adamar matrices of elements with the index 1/2N. For odd N this rule is equivalent to adding to the matrix of elements with the index $1/2(N-1)$ one row and one column whose element at their intersection is +1 and all other elements are 0. The orthogonality of functions in such a system, functions consisting usually of binary or ternary sequences, is self-evident but they are not ortho-normalized except when $N = 2^n$. Their spectral characteristics are easily determined with the aid of discrete Fourier transformation. This has been done for $N = 2,3,4,5$. Figures 2; references 6: 4 Russian, 2 Western (1 in Russian translation).
[217-2415]

ACOUSTICS SPEECH AND SIGNAL PROCESSING

NOTICEABILITY OF HARMONIC DISTORTIONS

INDLIN, Yu. A., All-Union Scientific-Research Cinematography and Photography Institute

[Abstract] The basic nature of acoustic equipment is the level of nonlinear distortions. Because a decrease of distortion in equipment is connected with large economic expenditures, it is advisable to attempt to reduce these distortions to a level at which the audience does not notice the distortions. This paper is concerned with the establishment of such a level for harmonic distortions, and a considerable number of findings along this line are presented. The noticeability of equipment harmonic distortions is determined by the levels: auditory harmonic distortion; masking of harmonic of main signal; and mixing of noise as well as the nature of the audible material. Figures 10; references: 20: 15 Russian, 5 nonRussian.
[282-6415]

EXTRA OPTIMIZATION OF DIGITAL INTERFERENCE ELIMINATION FILTERS BY SWITCHING CONTROL

ABRAMOVICH, Yu. I. and DANILOV, B. G.

[Abstract] The method of switching control, already used for discrete phase shifters in the case of very few quantization levels, is extended to extra optimization of digital interference elimination filters. The feasibility is demonstrated on an existing such filter with weight factors expressible in binary numbers with fixed decimal point. This representation facilitates not only optimization of the weight factors but also direct adaptive tuning of the filter through minimization of the estimate of interference power at its output. This is found to either improve the interference suppression with a given number of digits or require fewer digits for a given level of interference suppression. Figures 1; tables 1; references 6: 5 Russian, 1 Western.
[217-2415]

REAL-TIME SPECTRUM ANALYZERS

[Article by Lt Col V. Ponomarenko and Sr Lt A. Gerasimov in the section "New Measurement Devices"]

[Text] The operation of electronic equipment designed for use in the areas of hydroacoustics, low-frequency radio communications, sonar ranging, and monoimpulse radar requires analysis of the signal spectrum in real-time, that is, as the data is being received. For this purpose, spectrum analyzers currently in use employ compressed time functions, as well as fast Fourier-transform (digital).

Spectrum analyzers using the time-compression function are classified as hybrid, that is--analog-digital, devices. Such analyzers accomplish time-compression of the signal using digital methods in the recirculation delay lines and the shift registers, or through the use of a digital memory. To begin with, digital sampling of the signal is recorded in pace with the input of data, after which the samples are read very rapidly in a manner somewhat analogous to playing a record at high speed. Further analysis of the samples is done with a rapid-tuning sequential analyzer.

Representative examples of spectrum analyzers employing compressed time functions are such units as the S4-54, the SK4-72, and the SK4-72/2.

A spectrum analyzer which effects fast Fourier transformation of the signal--that is, its transference from a time to a frequency domain--is still referred to as a digital device, inasmuch as this kind of transformation can only be carried out through mathematical methods. For this reason, microprocessors are incorporated into digital analyzers. Normal operation of the analyzer requires that the data input rate not exceed the data processing rate. The upper limit of the frequency of a signal being processed depends on the response speed of the computing circuitry built into the device (analog-digital and digital-analog converters and the arithmetic unit).

The digital spectrum analyzers in real-time which are currently in use are usually dual-channel units. Since they incorporate microprocessors in their designs, they have a rather broad range of applications: they permit measurement of the spectral, correlational and statistical characteristics of signals, detection of signals hidden in noise, determination of critical frequencies of transfer functions and coherence functions related to them within complex systems, and the investigation of continuous, transient and isolated processes.

Prior to the advent of digital spectrum analyzers, all of the enumerated operations were carried out with the use of a wide assortment of devices: conventional devices for analyzing sequential operations, for measuring correlational and statistical characteristics, and for measuring nonlinear distortion and circuit parameters. The digital analyzer has replaced the entire gamut of these devices. The SK4-71, for example, which is now being put out by the industry, is an analyzer which performs the majority of the functions using interchangeable programs. In order to change its operating mode, one need only punch the proper key on the control panel to access the memory of the processor for the appropriate control program. Technical characteristics for several spectrum analyzers are shown in the table.

Analyzer Technical Characteristics	Spectrum Analyzer Model			
	S4-54	SK4-72	SK4-72/2	SK4-71
Frequency Range, Hz	0.05-2000	0.05-20,000	0.05-20,000	0.05-50,000
Number of Equivalent Filters, units	200	200	200	32-2048
Dynamic Range, dB	45	54	54	60
Dimensions, mm	480x240x475	600x1985x900	480x671x555	1200x1985x900
Weight, kg	27	210	85	550

BROADCASTING, CONSUMER ELECTRONICS

COMPUTER-AIDED ACCOUNTING AND DESIGN OF TELEVISION TRANSMITTERS NETWORK

KUBRAKOV, V. B., MANAYENKOVA, G. S., SEMENOV, V. V. and SHERGINA, Z. A.

[Abstract] Designing networks of television transmitters has been automated on a YeS-1022 computer with 512 kbyte memory and standard peripheral equipment. The computer calculates the useful range of a transmitter for zoning and layout on the basis of applicable laws governing wave propagation, field distribution, and electromagnetic compatibility. These relations, many of them with trans-cendental functions, are supplemented with appropriate limits and constraints as well as with algebraic approximations of CCIR propagation curves. A typical calculation of distances and carrier frequencies by the Fenton method illus-trates the capability of this computer-aided design system up to final selec-tion of the television channel for a reinstallable transmitter in an expanding network. Tables 1; references 3: 1 Russian, 2 Western.
[247-2415]

GENERALIZED RELATION FOR CAPACITANCE RATIO OF HIGH-FREQUENCY QUARTZ RESONATORS WITH PIEZOELECTRIC LENSES

POSTNIKOV, I. I.

[Abstract] An analytical relation is derived for the capacitance ratio of a high-frequency quartz resonator with piezoelectric lens, this ratio being defined as that of the equivalent dynamic one C_D to the static one C_0 with the stray capacitance of the crystal holder C_h added to C_0. The dynamic capaci-tance is calculated from the displacement distribution over the entire lens volume, an AT-cut being considered here specifically for the 0.75-10 MHz frequency range. The capacitance ratio $m = C_D/(C_0 + C_h)$ depends on the lens orientation and has been normalized to its maximum value, which in turn depends on the lens radius and the electrode radius. The relation for the absolute

maximum capacitance ratio is closely approximated by the simpler relation

$m_{a,max} \sim 1.59e^{-0.6\sqrt{C_h/C_0}}$, which obviates the need for computer-aided solution
of the corresponding boundary-value problem. The relation is extended to
resonators operating at mechanical harmonics. Figures 4; references:
6 Russian.
[247-2415]

DEVELOPMENT OF DIGITAL RADIO BRAODCASTING SYSTEM

Moscow ELEKTROSVYAZ' in Russian No 2, Feb 85 p 61

GORMAKOVA, N.

[Abstract] A report on the development of a digital radio broadcasting system
was presented by the All-Union Scientific Research Institute of Radio Broad-
cast Reception and Acoustics to the Scientific and Technical Council at the
USSR Ministry of Communication in April 1984. It dealt with encoding and
decoding of audio signals, modulation and demodulation of the radio-frequency
carrier, measuring instruments for checking the feedthrough channel, service
equipment for pickup of additional information contained in digital signals,
and preliminary testing of the first prototype version of such a system. No
conclusion about the feasibility of such a system and its compatibility with
existing analog systems can yet be drawn on the basis of this report. Follow-
ing a discussion, the Council approved the overall concept and the Institute's
activities toward its realization. Several recommendations were added,
especially important being selection of a single signal format for all channel
segments, emphasis on more reliable transmission as well as on electromagnetic
compatibility, and frequency-territorial assignment planning.
[247-2415]

UDC 621.373:621.397.6.072.6.078

EFFECTIVE PHASE-LOCK AUTOMATIC FREQUENCY CONTROL OF MASTER LINE-SWEEP
OSCILLATOR BY MEANS OF FREQUENCY-PHASE DETECTOR WITH LOGIC

Moscow RADIOTEKHNIKA in Russian No 2, Feb 85
(manuscript received after revision, 17 Jul 84) pp 33-36

RYSIN, A. A.

[Abstract] A master line-sweep oscillator has been designed for operation in
a 2-standard video terminal with respectively 15.625 kHz and 28.125 kHz sweeps.
It includes phase-lock automatic frequency control which does not require
switching the time constants of low-pass filters. Instead it uses a frequency-
phase detector with exclusive-OR logic and NAND logic. Inserted between the
input frequency divider and the frequency subtractor, it allows measurement of
the phase error twice during every period of its input signal. The hardware

includes a twin D-trigger, an asynchronous RS-trigger, an asynchronous JK-trigger, and three diodes--all built with series 133 integrated microcircuits. The oscillator with such a frequency-phase detector was tested in a 61LK3Ts kinescope over the 5-50°C temperature range. Frequency locking was reliable over the 15-29 kHz range, without noticeable image phase shift upon switching from one standard sweep to the other. Figures 5; references 5: 2 Russian, 3 Western.
[232-2415]

UDC 621.372.5

DESIGN OF PULSE CORRECTING NETWORKS FOR PULSE GENERATOR

ZIRKA, S. Ye. and MOROZ, Yu. I.

[Abstract] A method of designing passive two-pole networks for pulse correction is described, specifically applicable to correction of square video pulses by suppression of overshoots along the leading edge with minimum lengthening of the rise time. The gist of the method is the best smooth approximation of the overvoltage as function of time with a power-exponential relation, time being measured from the beginning of the pulse and normalized to the time at which the overvoltage reaches its maximum. Any residual pulse nonuniformity can be further minimized by addition of an inductance. The standard transient process corresponding to the required pulse form should be based on the pulse form prior to correction. The design of two-pole corrective networks for transformers and pulse modulators on phantom lines has been refined according to this method. Calculations have been programmed with use of standard subroutines. Figures 2; tables 1; references: 6 Russian.
[232-2415]

MODERNIZATION OF RTsTA-70 LOW-POWER TELEVISION RELAY

FRIDMAN, E. M., chief of laboratory, SHELEPEN', I. V., master laboratory specialist, KOROTYCHEV, V. I., senior laboratory engineer, and CHALENKO, V.L., master laboratory specialist

[Abstract] According to studies made at the Scientific Research Institute of Radio and Television Broadcasting (Kiev Department), the currently operating RTsTA-70 low-power (100 W) television relays for the I-II-III frequency channels will become obsolete within 15 years. In view of such a forecast, only complete modernization of this equipment will render it suitable for unattended automatically operating stations. The main thrust here is replacement of power tubes with power transistors. One important and effective way to make this possible is to combine amplification of radio-frequency video

signals and sound-track signals, which would moreover eliminate a large part
of the audio transmitter equipment as well as one radio-frequency feeder.
With a 10:1 power ratio of the two channels and the amplitude of beats varying
at the difference-frequency over a dynamic range of 0.69-1.31, this will
require availability of an extra power margin: at least 73% more peak power
and 55% more plate power without exceeding acceptable levels of intermodula-
tion and cross-modulation noise as well as of spurious radiation. Two schemes
are possible here, either amplifying each signal before adding them or adding
the two signals and amplifying their sum. The first scheme requires an
intricate adder and retains much of the sound track equipment, while the
second scheme requires a highly linear amplifier but will do with transistor-
izable low-power two adders. A third scheme evolves which is fully transis-
torized, all vacuum tubes having been stepwise replaced, requiring only a
small low-voltage power supply and no maintenance with attendant disassembly.
Figures 9; tables 1.
[236-2415]

CHOICE OF PARAMETERS OF A NEW TELEVISION BROADCASTING SYSTEM

PEVZNER, B. M., All-Union Scientific-Research Television Institute

[Abstract] The basic requirements of a future high-definition television
system are examined. It is concluded that such a system requires an increase
of the screen dimensions. Reproducing devices for the system should be
matrix-mosaic reproducing screens. Their properties exert a significant
effect on the system parameters; in particular, they perhaps remove the prob-
lem of flickering, thanks to which the possibility exists of using line
(progressive) scan at 25 frames. The following basic parameters of the new
systems are substantiated: discrete frequency of brightness signal 54 MHz
(system 16:8:8 in hierarchy digital codes with a chromaticity element equal to
a 2 x 2 brightness element), 1125 lines, 25 frame/s, frequency of line
[horizontal] frequency 28,125 kHz, aspect [picture] ratio 5:3, active frame
1642 x 1072 of brightness element, relation of horizontal and vertical
definition 1.53, a completely digital video channel. Figures 2; tables 1;
references 25: 17 Russian, 8 nonRussian.
[282-6415]

TELEVISING RAPIDLY PROCEEDING PROCESSES

GRYAZIN, G. N., Leningrad Institute of Precision Mechanics and Optics

[Abstract] The possibilities are analyzed of creating a television method for
observing and measuring the parameters of processes which occur in various
areas of motion pictures and television, the lifetime of which ranges from a

portion of a millisecond to tens of milliseconds and more. The prospects
for developing pulse television systems under present conditions are consid-
ered. A block diagram and the classification of such systems are shown.
Figures 1; references 11: 10 Russian, 1 nonRussian.
[282-6415]

THE 90K53 NEW PORTABLE TWO-CHANNEL MIXING CONSOLE

BYSTROV, B. Z., KOLOSKOV, A. V., OBUKHOVICH, N. L. and PLYUSHEVA, O. V.,
Central Design Office, Scientific-Industrial Union

[Abstract] At present in domestic practice consoles for original recording
of sound are developed and serially produced with one output channel, for the
most part of the transportable type, the mass of which equals or exceeds 10
kilograms. The domestic portable mixing console, the 90K43, developed in
1972 (mass 2.5 kilograms) has five input and one output channel, but today it
is already obsolete. At the same time the requirements of motion picture and
television studios for portable consoles with wide functional possibilities
and a sufficient number of input and output channels constantly increases:
they are necessary for recording musical ensembles and noises in visiting and
experimental conditions. The basic technical characteristics of the new 90K53
portable two-channel mixing console are described in this paper. A functional
diagram and the electroacoustic characteristics of this console are presented.
The 90K53 is recommended for production. Figures 3; references: 1 Western.
[282-6415]

NEW SYSTEMS OF TELEVISION AND TERMINOLOGY

NOVAKOVSKIY, S. V., doctor of technical sciences, professor

[Abstract] This brief letter received in the editorial mail of TEKHNIKA KINO
I TELEVIDENIYA discusses the creation of new television systems with an
increased definition of image and 1/25-2625 number of scan lines.
References: 7 Russian.
[282-6415]

DIGITAL VIDEO RECORDING

KHLEBORODOV, V. A., KOMAROV, A. D., All-Union Scientific-Research Institute of Television and Radio Broadcasting

[Abstract] The paper is concerned with the First Draft International Standard On 19-mm Digital Video Recording developed by the Joint Interim Working Group 10-11/4, Consultative Committee on International Radio (CCIR). Two tables are presented: 1) Proposal with respect to format of digital phonograms; and 2) Examples of realization of digital magnetophones with proposed digital video phonograms. The following figures are shown: 1) Principles of segmental video recording, guaranteeing compatibility of video phonograms in standards 525/60 and 625/50; 2) First proposal with respect to format of digital video phonogram on the basis of 25-mm tape (1982); 3) Design of format of digital video phonogram on basis of 19-mm tape, proposed by Joint Temporary Working Group 10-11/4, CCIR (1984); and 4) Proposed by firm Bosch (1984). Detailed conclusions are included. Figures 4; tables 2; references 7: 2 Russian, 5 nonRussian.
[282-6415]

OPERATION OF SAEM EDITING COMPLEX

PANCHENKO, S. V., PONOMAREV, V. V., Sochinskiy Radio Telegraph Station, GONCHAROV, A. V., All-Union Scientific-Research Television and Radio Broadcasting Institute

[Abstract] The paper considers a complex for automatic electronic editing of television programs, the SAEM, which entered into operation in 1982 at the Sochinskiy Radio Telegraph Station. The DK3000 system of electronic editing developed by the Central Institute of Television and Radio Broadcasting (German Democratic Republic) and the Video Magnetophone "KADR-5" enters into the composition of the complex. Similar complexes also operate at a number of other Soviet telecenters. Figures 3; tables 2.
[282-6415]

JAPANESE-SOVIET SYMPOSIUM ON MOTION PICTURE-TELEVISION TECHNICS

ARTIPIN, M. V., rector Leningrad Institute of Motion Picture Engineers, doctor of technical sciences, professor

[Abstract] At Tokyo in October 1984 the twentieth year of the Society of Japanese-Soviet Communications was concerned with a symposium on motion picture-television technics. The symposium was organized by the Society of Japanese-Soviet Communications and the Japanese Association of Technical Workers. It was conducted by the NAC (not expanded) firm. The Chairmen of the symposium were the president of the NAC firm, K. Nakadzima and the rector of the Leningrad Institute of Motion Picture Engineers, Professor M. V. Antipin. A detailed account of the symposium's activities is furnished.
[282-6415]

UDC 621.382

DIGITAL CORRECTION OF NONLINEAR DISTORTIONS OF THE VIDEO SIGNAL OF CHARGE COUPLED DEVICE--IMAGE RECEIVERS

KRIVOSHLYKOV, A. Yu., SAKHNO, S. P., and TYMCHIK, G. S., Kiev Polytechnical Institute

[Abstract] A method is proposed for digital processing of the video signals of a charge-coupled device--receiver which makes it possible to perform an automatically operated correction of its nonlinear distortions. Correction of the nonlinear distortions of the video signal was realized on an experimental unit, a block diagram of which is presented. This experimental unit consists of a coherent optical spectrum analyzer, a charge-coupled device--receiver, and a M-6000 minicomputer. Block diagrams are presented of algorithms for synthesis of the light characteristics and correction of the video signals. The results of experiments concerned with synthesis of light characteristics are presented in a figure. The experiments showed that the method in question made it possible to obtain useful linear characteristics of the system of processing a video signal. Figures 3; references: 4 Russian.
[252-6415]

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VIDEO EFFECTS IN TELEVISION

MAKARENKO, A. A., All-Union Scientific-Research Television Institute

[Abstract] Video effects currently used in television broadcasting are reviewed. A functional diagram is presented, which, with the exception of some details, is typical of world-wide video effect units. The majority of video effects are produced on the basis of a combination of elementary geometrical transformations. Plane motion, axial symmetry or reflection, similarity transformation, affine transformation, projection transformation, and non-linear transformation are reviewed in this connection. Methods of forming video effects are described with the aid of detailed figures. The present and future states of video effects are evaluated. Figures 9: references 23: 7 Russian, 6 Western.
[6415/219]

MAGNETIC TAPE FOR DIGITAL VIDEOTAPE RECORDERS

OLEFIRENKO, P. P., All-Union Scientific-Research Television and Radio Broadcasting Institute

[Abstract] This paper is concerned with a choice of a magnetic material, its properties, and the thickness of the magnetic layer of tapes used for digital videotape recording. The longitudinal and transverse recording density, the thickness of the working layer, and the properties of magnetic particles are examined. The results of high-density recording on various tape transports are shown in a table. It is concluded that the most suitable magnetic material for digital videotape recording is a powder of ferrum particles with a 80/96 kA/m coercive force. Other powders are described. Tables 1; references 24: 2 Russian, 22 Western.
[6415/219]

KZF-7 AND KZF-9 OPTICAL SOUND TRACK RECORDING EQUIPMENT COMPLEXES

GLAZUNOVA, V. I., KARPOV, I. V., NIKIFOROV, V. F., RAKOVITSKIY, G. R., TsBK NPO "Ekran" (Central Design Office for Motion Pictures; Research and Production Association "Screen")

[Abstract] The following information is presented with respect to the KZF-7 and KZF-9 optical sound track recording equipment complexes: 1) Principal

technical indices for the complexes; 2) Technical indices of amplitude compressor of KZF-9 complex; 3) Overall view of KZF-7 complex; 4) Optical train of 2D37 and 2D39 light-modulating devices; and 5) Photograph of 2D39 device. The complexes, now recommended for production, were developed with an allowance made for information acquired during production and operation of the KZF-1 and KZF-3 photographic sound recording equipment used in the USSR from the beginning of the 70ths. Figures 4; references: 1 Russian.
[219-6415]

AUTOMATION OF TELEVISION PRODUCTION TECHNOLOGICAL PROCESSES

MUSATOV, I. A., 50th Anniversary of October Television Technical Center

[Abstract] The basic trends in automation of television production technological processes considered in this paper reflect concepts received as the result of analysis, and by a number of operations accomplished during recent years by leading specialists of the large multi-program television center-- 50th Anniversary of October Television Technical Center. The following items are considered: 1) Editorial-director preparation of broadcast; 2) Coordination of work with respect to creation of broadcast; 3) Automation in video maintenance; 4) Technical maintenance of equipment operation; and 5) Creation of broadcasts and programs. General programs of automation are also listed. References: 7 Russian.
[219-6415]

DISTANCE EVALUATION WITH PRECISE FOCUSING AT DEFINITION

YURIZDITSKIY, S. P., "Leningrad Film" Motion Picture Studio

[Abstract] This "exchange of experience" is concerned with the development of a more accurate focusing method with respect to the object points at the frame edge--this in the case of wide screen filming with the use of wide-angle lenses. Two figures are used in the discussion: 1) Field of anamorphic motion picture frame with the photographic objective BAS-12, $f' = 30$ mm; and 2) Change of distance for object located at edge of motion picture frame (angular field of image $2\omega=72°$). In the majority of practical cases the distance to the object and the moment of filming varies but little. Consequently, it is only necessary to take these changes into consideration with the necessity for precise focusing at definition. Figures 2.
[219-6415]

IMPROVEMENT OF 'RHYTHM-REPEATER' AND 'RHYTHM-310' MAGNETIC TAPE RECORDERS

GEL'PERN, G. A., GERTSEVA, I. A., GUDASOV, V. V. and TSEDILIN, V. M.,
TsBK NPO "Ekran" (Central Design Office for Motion Pictures; Research and
Production Association "Screen")

[Abstract] Improvements in the currently-used "Rhythm-Repeater" and "Rhythm-
310" magnetic tape recorders are described. The following problems are con-
sidered: 1) Control of synch channel; 2) Modernization of system for display
of synchronism (which has substantial deficiencies); 3) Alteration of synchro
attachment for "Rhythm-Repeater" magnetic tape recorder; 4) Alteration in
"Rhythm-310" magnetic tape recorder; 5) Amplifier for "Rhythm-Repeater";
6) High-frequency filters; and 7) Phantom feed of microphones. Figures 3;
references: 2 Russian, 1 nonRussian.
[219-6415]

NONINDUCTIVE AUTOMOBILE RADIO RECEIVER

MARKIN, V. V., MASLENNIKOV, V. V., and SIROTKIN, A. D.

[Abstract] A noninductive automobile radio receiver is described with the use
of two block diagrams. The principal characteristics are: range of received
frequencies, 150-4120 kHz; sensitivity in the long-wave and medium-wave bands -
35 mkV, in the short-wave band - 50 mkV; selectivity with respect to image
channel - 60 db, with respect to adjacent channel - 40 db; output power,
1.5 W, quiescent current, 50 mA; number of adjustment points, 5. The circuit
includes double frequency conversion and wide-band preselection. Tuned and
nontuned multivibrators made with integrated assemblies and transistors are
used as local oscillators. Figures 2; references: 3 Russian.
[202-6415]

FIBER-OPTICAL SENSOR OF LINEAR ACCELERATORS

GORSHKOV, B. G., KUTAKHOV, V. P., SEN'KO, V. V., KHATIN, G. A., and YAREMCHUK, V. A.

[Abstract] The creation of a passive fiber-optical sensor of linear acceleration is reported and an analysis is given of its sensitivity. The performance of the sensor is based on the effect of losses of optical radiation at the bend of a multimode light guide. These losses result as the consequence of the conditions of propagation of higher modes in a curved waveguide, during which the numerical aperture of the light guide is narrowed, and more complicated processes also take place. The results obtained point to prospective use of the effect of losses of optical power at the bend of a light guide for creation of passive-optical sensors of physical parameters. Figures 5; references: 6 Russian.
[202-6415]

MILLIMETRIC-WAVE ANTENNAS AND DEVICES: REVIEW

VOSKRESENSKIY, D. I., MAKSIMOV, V. M., RUD', S. V. and SUKHAREV, I. G.

[Abstract] Millimetric waves are eminently suitable for many applications in
the national defense and in the national economy, ranging from detection of
low-flying objects to meteorological, geological, and medical research. They
occupy a unique position in the electromagnetic spectrum, namely between
optical waves and radio waves. They thus share some properties with both.
Their interaction with gases and especially water vapor in the earth's atmos-
phere has important practical implications and poses extra problems such as
buildup of amplitude and phase fluctuations, fluctuations of the propagation
path and the arrival angle, power losses due to heating in metals and in
dielectrics. Most important and interesting among millimetric-wave devices
are waveguides, antennas, and antenna auxiliaries. Waveguides are essentially
the same as those used for other wave bands, however here there is a choice
available between optical or radio-technical methods of energy channeling.
Waveguides or transmission lines which have been and are being developed
include rectangular and circular single-mode and multimode metal ones,
helical ones, metal-dielectric ones, solid and hollow cylindrical dielectric
ones, Y-dielectric ones, microstrip lines, dielectric image lines, dielectric
strip in substrate, dielectric strip on substrate, grooved open ones and
slotted closed ones. Millimetric-wave antennas, on the other hand, require
special manufacturing precision on account of critical lossiness and narrow
transparence windows in the earth's atmosphere. Antennas which have been
and are being developed include mirror antennas with configurations such as
Cassegrain or Gregori and with mechanical scanning, lens antennas using
dielectric or metal-plastic lenses and electric control of the refractive
index, microstrip lines, randomized arrays with large interelement distances
for maximization of the electrical length, antennas with surface-wave to
volume-wave conversion based on diffraction electronics with very effective
decoupling of reception and transmission, and multibeam antennas with inter-
mediate-frequency radiation pattern shaping circuitry. Further developments
expected in the near future are dielectric integrated circuits, holographic
control, improved dielectric rod antennas, nondirectional spiral antennas,
and ferroelectric traveling-wave antennas, as well as adequate auxiliary
devices such as antenna feeders, phase shifters, and attenuators. Figures 13;
tables 3; references 121: 48 Russian, 73 Western.
[245-2415]

COUPLED RADIO HOLOGRAPHY PROBLEMS

VORONIN, Ye. N.

[Abstract] The uniqueness principle applicable to solution of external and
internal problems of electrodynamics, with the electromagnetic wave field a
unique space-time function of its sources, is applied to radio holography and
specifically to a radio imager as discriminating device. The generalized basis,
whether a system of Green functions or radiation patterns characterizing
coherent multiposition receivers, is supplemented with an artificial basis
characterizing an artificial medium. This extends the scope of solvable radio
holography problem so as to include, in addition to internal, external, and
reverse problems of diffraction, also coupled problems such as selective
positive or negative discrimination, adaptive discrimination, and interference
suppression. This basis must also satisfy the corresponding set of Maxwell
equations, the divergence theorem, and continuity of tangential field com-
ponents on both inside and outside of boundaries between natural medium and
artificial medium having finite electrical conductivity each. The specific
basis is selected so as to yield a solution to the corresponding set of Maxwell
equations under given physical and geometrical constraints. When solution
not only by analytical methods but even by numerical methods is not feasible,
experimental methods are most expediently aided by breakdown of the problem
into the simplest particular cases or by simple but adequate approximation of
the basis, depending on the kind of or absence of a priori information. This
is demonstrated on the case of a homogeneous artificial medium. The basis,
including its integration operators, is conveniently represented in matrix
form. Figures 2; tables 1; references 26: 20 Russian, 6 Western (2 in Russian
translation).
[245-2415]

INTEGRAL CHARACTERISTICS OF PLANE-PARALLEL FINITE WAVEGUIDE ARRAY WITH
DIELECTRIC SLUGS

MANUILOV, B. D. and YAKOVENKO, V. A.

[Abstract] A plane-parallel finite array of antenna waveguides with dielectric
slugs and an infinitely large conducting flange is considered, of interest
being the dependence of radiation efficiency, directive gain, and beam orienta-
tion error on the deflection angle of the scanning beam. The analysis is based
on the electrodynamic model with transverse excitation. The field components,
which must satisfy the corresponding Maxwell equations and boundary condi-
tions, are calculated by the method of partial regions with application of the

Lorenz lemma and the Galerkin method with waveguide harmonics as basis func-
tions. The resulting infinite system of linear algebraic equations is regu-
larized and then put in the form of partitioned matrices, whereupon double
integrals in the matrix coefficients are reduced to single ones and these are
evaluated in quadratures. Energy balance in the system serves as the criterion
for monitoring and validating the solution. The algorithm has been programmed
for a YeS-1022 computer and was applied to antenna arrays of N = 9, 15, 27,
39, 101 elements. Juxtaposition of the results with data on phasing and the
reflection coefficient reveals the mechanism of the "blind spot" effect and
indicates means of reducing it. Figures 4; references 6: 4 Russian, 2 Western
(both in Russian translation).
[245-2415]

SYNTHESIS OF LOG-PERIODIC ANTENNAS WITH PRESCRIBED GEOMETRY

YATSKEVICH, V. A.

[Abstract] The synthesis of log-periodic dipole antennas for wideband short-
wave or ultrashort-wave communication systems is shown, assuming a prescribed
array geometry with the oscillator connected to the smallest dipole and with
currents in or voltages across the dipoles predetermined for best approxima-
tion of the prescribed radiation pattern. The problem of synthesis reduces to
calculation of the y-parameters of the connecting four-pole networks which will
yield the prescribed amplitude-phase distribution. The procedure begins with
synthesis of purely reactive and thus lossless four-pole networks for a fixed
single frequency, preferably for the lower limit of the frequency range so that
the frequency characteristics of those y-parameters can then be calculated
directly without need for additional data, while the input impedance of the
antenna is made purely resistive. A reactive feed system is synthesized next
according to conventional methodology, which has been simplified for a series
rather than parallel feed system. Assuming both current and voltage distribu-
tions to be known, one normalizes them through multiplication by the same con-
stant factor which is determined from the relation between input power and
output power in accordance with the law of energy conservation. Minimum-phase
four-pole networks are considered for physical realization of mathematically
established frequency characteristics with reactive circuit elements. The
procedure is demonstrated on synthesis of an asymetric array of vertical
dipoles above a plane surface, with the characteristics of such a log-periodic
antenna approaching those of a classical variable-phase one. Figures 4;
references 8: 4 Russian, 4 Western (3 in Russian translation).
[245-2415]

REDUCING HARDWARE COST AND CALCULATION TIME IN PHASE COMPUTER FOR ANTENNA ARRAY

ZAYTSEV, V. A.

[Abstract] Phase computers operating in a parallel binary code for phased antenna arrays are shown to optimize the beam sweep control. Code switching, approximations, and rounding make it possible to calculate the control codes for phase shifters in less time and with less costly hardware rather than with more costly hardware as position reckoning would. Rough design estimates based on selection on the microcircuit series as elemental base for required summations and multiplications confirm this conclusion, which is demonstrated for cylindrical antenna arrays but applies also to linear and plane ones. Figures 5; references 8: 6 Russian, 2 Western.
[245-2415]

SELECTION OF ADAPTATION CHANNELS FOR ANTENNA ARRAYS

SAMYLENKO, V. I. and GRUBRIN, I. V.

[Abstract] A method of optimally selecting m adaptation channels among n available output channels of an n-element antenna array is outlined and mathematically formulated, the purpose being to avoid "complete" adaptation of all channels and thus to reduce the unwieldy volume of calculations proportionally to the number of channels cubed with a resulting more efficient and precise algorithm. The method involves construction and evaluation of a matrix A with exactly m unities optimally spaced on the diagonal so as to

minimize the functional $\eta = \sum_{i=1}^{l} \|w_i - v_i\|^2$ ($v_i = Aw_i + v_{0i}$, $Av_{0i} = 0$, $w_i \in c^n$,

$v_i \in c^{m,n}$, c^n denotes n-dimensional complex Euclidean space and $c^{m,n}$ denotes m-dimensional subspace of n-dimensional complex Euclidean space). The algorithm is applicable to adaptive space-time or only space processing of wideband signals by phased antenna arrays, also to solution of antenna design problems such as geometrical layout of array elements. It has been programmed for a YeS-1055 computer and was executed in two test experiments with a 12-element equidistant linear array of isotropic dipoles. In both experiments were given five different situations involving two interference signals, the power of each 1000 times higher than the internal noise power in the adaptive antenna array, arriving from different directions in various combinations first from the same side and then from opposite sides of the array. Figures 1; references 8: 3 Russian, 5 Western (1 in Russian translation).
[245-2415]

RADIOOPTICAL ANTENNA ARRAYS FOCUSED INTO FRESNEL REGION

GRINEV, A. Yu., VORONIN, Ye. N. and YANKOVSKIY, O. F.

[Abstract] Radiooptical antennas focused into the Fresnel region yield data
not only about the space coordinates and the spectrum of an object located
within that region but also about the wavefront curvature at the antenna aper-
ture so that not only the distance of an object but also its shape can be
determined. Application of this principle is demonstrated on the process of
data restoration in a passive radar system. Just as in the case of objects
located in the Fraunhofer region, the coherent optical processor of a given
multielement receiver antenna is to form a brightness distribution proportional
in magnitude and geometrically similar to the radiation pattern of a luminous
object on the basis of the detected wave field. Such data processing is treated
as an electrodynamic problem of electric and magnetic currents distribution.
The solution to the corresponding integral equation, with the Green function
for an array element as kernel, is sought in the form of a superposition of
the measured voltage on the optimum with respect to focusing amplitude-phase
distribution of antenna excitation. With the Fresnel region formally defined
as the region of plane elementary waves, the general algorithm of data restora-
tion is particularized first for a plane radiooptical antenna array of identi-
cal element and then for a linear one with optical spectrum analyzer as well
as space-time processor, also for a cylindrical one and a fundamentally simi-
lar to it a fundamentally one similar to its annular one. Figures 5;
tables 1; references 8: 7 Russian, 1 Western.
[245-2415]

BOUNDARY WAVES IN FINITE ANTENNA ARRAYS

FILIPPOV, V. S.

[Abstract] Boundary effects in a finite antenna array are analyzed by the
superposition method, a method less unwieldy and more consistent with the
physical nature of the subject than direct numerical methods of solving
boundary-value problems of electrodynamics and methods based on an infinite-
array model with high concentration of elements in the central region. Accord-
ing to this method the currents in the radiator elements of a finite array are
represented as superpositions of quiescent currents in a periodic infinite
array, of which the given finite array is a part, and a boundary wave propa-
gating from the edge of that finite array inward. An obvious prerequisite
for validity of this method is existence of boundary waves, rigorously

demonstrated here for a semiinfinite plane discrete array of narrow infinitely long parallel slots coupled through matching circuits to the antenna feeders. The theory of such an array leads to an equation solvable by the Wiener-Hopf method with factorization and numerical integration, but more expediently reduced to a Fredholm integral equation of the second kind with a weakly polar kernel for the limiting case of a continuous array. A special case is an array phased in the direction tangential to the shield with a voltage equal to that of the boundary wave, this case coinciding with boundary refraction. In the more general case excitation of a boundary wave is regarded as equivalent to action of fictitious sources forming an array of parallel magnetic current filaments. Following a qualitative analysis, the resulting system of equations of a boundary wave is found to be solvable by direct numerical methods for simpler antenna array configurations but only by a special iteration method for more intricate configurations. The iteration procedure, with use of Fourier transformation and asymptotic estimates, is based on complementing the given finite array to an infinite one with radiators under matched loads and then subtracting from the resulting boundary wave the contribution of this complementary array. Figures 2; references 3: 1 Russian, 2 Western (1 in Russian translation).
[245-2415]

SCATTERING BY CYLINDER WITH ANISOTROPIC IMPEDANCE

KLIMOV, A. V., PETROV, B. M. and SEMENIKHIN, A. I.

[Abstract] Scattering of plane waves by an isotropic cylinder with anisotropic coating is considered, for the design of radar reflectors and shaping of secondary fields. The corresponding boundary-value problem for the distribution of surface impedance is formulated in accordance with physical optics and reduced to a system of two equations with six unknowns, which leaves four degrees of freedom for combinations of resistances and reactances. Special cases are zero reactances only and zero resistances only, a more general case being rotation of the principal axis of the impedance tensor so that neither reactances nor resistances are zero. The problem is solved rigorously by the "separation of variables" method, for a cylinder of arbitrary cross-section inside a circumscribing circular cylinder with the smallest possible radius and with the Lorenz lemma in integral form applicable to the region between both cylindrical surfaces. Infinitesimally thin electric and magnetic current filaments as sources of the auxiliary field are placed first inside the inner cylinder and then outside the outer one. Subsequent numerical evaluation of the scattering matrix for E-mode and H-mode waves indicates that the distribution of the reactance tensor on the surface of square, equilaterally triangular, and parabolic cylinders is such as to allow reduction of the backscattering level in planes of matched polarizations by up to 20 dB below the level of backscattering by an ideally conducting reflector, with all radiation of the secondary field transferred to crosspolarization. Figures 2; references: 3 Russian.
[245-2415]

MATRIX ANALYSIS OF PERIODIC INTERLEAVED MULTIFREQUENCY ANTENNA ARRAYS

PONOMAREV, L. I.

[Abstract] The scattering matrix is constructed for periodic interleaved multifrequency antenna arrays with radiators of q different types within the overall antenna aperture, all radiators of each type excited at the same frequency f_q. A plane doubly periodic antenna array is considered and on the basis of its finite-dimensional scattering matrix are derived expressions for total gain and surface utilization factor. Calculations by conventional methods of electrodynamics are made for an antenna array which operates in the transmitting mode or in the receiving mode, with power rereflection in the latter case, with the radiation field at each frequency represented as a finite Floquet spectrum containing TE-mode and TM-mode plane harmonics. The results of this analysis are used for optimizing the excitation pattern so as to suppress additional side lobes in the antenna radiation pattern at high frequencies, while only plane interference side lobes appear at low frequencies and these can be suppressed by reducing the mismatch between radiators. Figures 5; references 11: 7 Russian, 4 Western (1 in Russian translation). [245-2415]

ANALYSIS OF MULTIMODE WAVEGUIDE-TYPE POWER DISTRIBUTOR

LIKHODED, Yu. V. and PONOMAREV, L. I.

[Abstract] Characteristics of a power distributor which consists of a multimode waveguide excited by several waveguides on the input side and loaded by an array of receiver waveguides on the output side is analyzed, for extending the application of such devices from centimetric-wave power to millimetric-wave power. The corresponding boundary-value problem of electrodynamics is solved numerically in two stages, evaluation of the scattering matrix for the multipole network representing the function of an array of waveguides with smaller cross-section and a waveguide with larger cross-section followed by evaluation of the scattering matrix for a finite array of such multipole networks representing the complete power distributor. In the first stage the smaller waveguides are assumed to be filled with dielectrics having generally a different permittivity each and to contain matching dielectric slugs of appropriate thickness and permittivity each. The transverse electric and magnetic field components are expanded into series of vector eigenfunctions separately for the two characteristic regions, the orthogonal basis vector eigenfunction

having the same form for both regions and being calculated with the aid of the scalar potential. The second part of the solution is obtained by conventional methods. The entire algorithm has been programmed in FORTRAN. Figures 4; references 5: 2 Russian, 3 Western (1 in Russian translation). [245-2415]

ELECTROMAGNETIC FIELD IN VICINITY OF EDGES OF DIELECTRIC BAR WITH SUBSTRATE

VESELOV, G. I. and PLATONOV, N. I.

[Abstract] The electromagnetic field in the vicinity of edges of a dielectric bar with a substrate and otherwise smooth surfaces, representing a rectangular dielectric waveguide inside a nonhomogeneous medium, is calculated by the Meixner method in a cylindrical system of coordinates (r, ϕ, z). Internal inconsistency is avoided by treating this method as an asymptotic one upon approaching an edge $r \to 0$. The algorithm for electromagnetic fields in the vicinity of an edge common to surrounding wedge regions is modified for this case by representing the field when $r - 0$ as the superposition of three sets of fields: 1) $\vec{E}, \vec{H}_z = O(r^\tau)$, $\vec{H}_t = O(r^{-1+\tau})$ ($\tau = \tau_\mu$ denoting the smallest positive root of the transcendental equation $F_\mu(\tau)=0$); 2) $\vec{E}_t = O(r^{-1+\tau})$, $\vec{E}_z, \vec{H} = O(r^\tau)$ ($\tau = \tau_\varepsilon$ denoting the smallest positive root of the transcendental equation $F_\varepsilon(\tau)=0$); 3) $\vec{E}_t, \vec{H}_t = O(r)$, $\vec{E}_z, \vec{H}_z = O(1)$. It thus is applicable to various combinations of not only dielectric permittivities but also magnetic permeabilities. Figures 2; references 5: 2 Russian, 3 Western (1 in Russian translation). [245-2415]

PRINTED-CIRCUIT DUAL-FREQUENCY RADIATOR

FILIPPOV, V. S. and SHATOKHIN, B. V.

[Abstract] Printed-circuit radiators with rectangular metal cladding on the dielectric substrate are capable of operating in the dual-frequency mode, owing to orthogonality of the respective two polarization planes with an appropriate difference between length and width. A design and performance analysis, with the aid of numerical and experimental data, reveal the useful properties of such radiators as well as the penalty in polarization characteristics for dual-frequency rather than single-frequency operation. Figures 2; references: 2 Russian.
[245-2415]

EXCITATION OF ARRAY OF PLANE-PARALLEL WAVEGUIDES COVERED WITH DIELECTRIC LAYER OF FINITE LENGTH

MANUILOV, B. D. and SHABLOVSKIY, V. M.

[Abstract] An antenna array of plane-parallel waveguides under a dielectric layer of finite length is considered and excitation of such an array with T-mode waves is analyzed, assuming metallized lower and lateral surfaces except the aperture and an infinitely large ideally conducting flange around the dielectric layer on the upper surface. The corresponding boundary-value problem is solved by the method of partial regions, with superposition of waves inside the waveguides and on the basis of the Lorenz lemma for the dielectric layer as well as for the remaining half-space. The resulting system of integral equations is solved by the Galerkin method. A typical numerical experiment has yielded quite accurately both the efficiency and the directive gain, with the number of terms equal to the number of waves propagating through a plane waveguide with dielectric filler. It also reveals the dependence of the beam orientation error near antiresonance on the beam deflection angle, attributable to prevailing electrodynamic effects.
Figures 3; references 2: 1 Russian, 1 Western (in Russian translation).
[245-2415]

USE OF ACTIVE QUENCHING FOR REDUCTION OF POWER DISSIPATION IN DIPOLE ANTENNA ARRAY

PONOMAREV, L. I., DOLGIN, A. V. and SHATALOV, A. V.

[Abstract] Reduction of power dissipation in dipoles upon incidence of plane waves by means of an oscillator coherent with the field of such a wave is extended from a single thin dipole to a finite periodic array of thin dipoles with an arbitrary direction of incident waves. The problem reduces to a system of Gallen integral equations for unknown currents and the solution is sought which minimizes the current norm. Calculations for an array with a period $d = 1.8\lambda$ (λ - wavelength) in both H-plane and E-plane, composed of 0.007 thick and 0.625λ long dipoles reveal that the quenching effectiveness factor depends only slightly on the angle of wave incidence. Varying the dipole dimensions reveals that it decreases fast with increasing dipole thickness and peaks to a maximum at some dipole length corresponding to resonance. Figures 3; references: 1 Russian.
[245-2415]

SIGNAL AND INTERFERENCE LEVELS IN ANTENNA ARRAY WITH OPTIMUM RADIATION PATTERN

POPOV, A. S.

[Abstract] An antenna array is considered which has an optimum radiation pattern, with the minimum mean-square deviation of the vector of weight factors as the optimality criterion and this vector described by the Wiener-Hopf matrix equation. Power of the useful signal and total power of all interference signals in such an array are calculated on this basis, assuming mutually noncorrelated signal, interference, and thermal noise. The results reveal that signal power and interference power as well as combined output power all depend on the signal-to-(interference+noise) ratio at the output. They also indicate the attainable power characteristics of such an antenna array. Figures 2; references: 2 Western.
[245-2415]

EFFECT OF CORNER REFLECTOR ON FIELD OF LINEAR RADIATOR

[Annotation of article No 389, deposited at the Center of Scientific and Technical Information 'Informsvyaz'', 21 pp with 6 figures and 22 bibliographical references]

PIMENOV, Yu. V. and SALAKH, A. K.

[Abstract] The effect of a corner reflector in the vicinity of an electric dipole on the radiation pattern of the latter is treated as a two-dimensional problem and solved using two systems of coordinates, a Cartesian one and a cylindrical one with common origin O and z-axis. The "infinitely large surface" method reduces the problem for the reflector cross-section and contour to an integral equation for the current density distribution induced in the reflector. This equation is in turn solved in two successive approximations, the first one corresponding to symmetric excitation. The resulting expressions for the electromagnetic field in the second approximation apply to any point in space, but they simplify for the far-field region.
[232-2415]

LONGITUDINALLY SLOTTED CYLINDRICAL SHIELD WITH FINITE THICKNESS AND
ELECTRICAL CONDUCTANCE

DZHALA, R. M.

[Abstract] Diffraction of electromagnetic waves by an open hollow cylindrical
shield with a sectoral longitudinal slot is analyzed, considering that it has
a finite thickness and a high but also finite electrical conductance. The
corresponding boundary-value problem for an infinitely long slot of finite
width and for, specifically E-polarized incident waves is reduced to an
infinite system of linear algebraic equations of the second kind. The field
inside the slot is determined from a transcendental equation which follows
from the Leontovich conditions at the lateral edges and takes into account
the skin effect. A solution in the approximation of a narrow slot is obtained
for the amplitude coefficients of diffraction harmonics and of the field of
the cylindrical wave penetrating inside, also for the natural frequencies of a
thin shield and a thick shield with "effective widening" of the slot.
Figures 2; references 18: 16 Russian, 2 Western (both in Russian translation).
[217-2415]

RADIATION PATTERN AND REDUCED GAIN OF LINEAR ANTENNA
IN TURBULENT ANISOTROPIC ATMOSPHERE

ARMAND, N. A., KIBARDINA, I. N. and LOMAKIN, A. N.

[Abstract] The radiation pattern and the directive gain of a linear antenna
in a turbulent atmosphere are calculated, taking into account anisotropy of
large-scale inhomogeneities as well as phase dispersion of radio waves at the
antenna aperture. The atmosphere is treated as a statistically nonhomogeneous
medium with different vertical and horizontal space correlation lengths.
Measurements, with vertical and horizontal interferometers, as well as calcu-
lations of phase difference fluctuations depending on the antenna elevation
angle and of radiation pattern distortions depending on the antenna orienta-
tion relative to the Earth's surface indicate that a horizontal antenna is
much more preferable to a vertical one for low-angle observations. Figures 6;
references 13: 11 Russian, 2 Western (1 in Russian translation).
[217-2415]

LOADED ANTENNA AS VARIABLE-IMPEDANCE DIPOLE

LEVIN, B. M. and YAKOVLEV, A. D.

[Abstract] An antenna with loads is treated as a dipole with longitudinally
variable surface impedance, for synthesis of a wideband dipole. On the basis
of a very important assumption, namely equivalence of a dipole with lumped
loads and one with distributed impedance, the radiation pattern is calculated
first for a simple linear current distribution and then for a more flexible
exponential one. The equivalence assumption has been validated by control
calculations and measurements over the 12.5-100 MHz frequency range, using an
asymmetric dipole antenna 6 m tall with a 6.67 mm radius and a linear current
distribution over its ten 0.6 m long vertical segments. Capacitance and
inductance are considered for selection as load elements, their assortment and
magnitudes depending on the required amplitude-phase distribution and on the
input impedance required for matching. It is taken into consideration that
the input impedance of a dipole has not only an inductive component associated
with pickup but also a resistive component determined principally by the
intrinsic radiation resistance. Figures 5; references 6: 3 Russian, 3 Western.
[217-2415]

EXCITATION OF BICONICAL CONDUCTOR

GOSHIN, G. G.

[Abstract] Excitation of a biconical conductor is analyzed, for the design
of biconical antennas with elliptical polarization. The corresponding problem
of electrodynamics is formulated in a spherical system of coordinates, for an
ideally conducting biconical surface with each nappe excited at a narrow
annular slot and only a TEM mode being excited by a source at the vertex. The
problem is solved by Kantorovich-Lebedev integral transformation of the wave
equations, taking into account the harmonic variation of both electric and
magnetic Debye potentials as functions of the circumferential coordinate. The
behavior of the solution upon approaching the vertex indicates that the current
decreases to zero and the normal component of the electric field acquires a
singularity. The antenna behaves, therefore, as one open at the center.
Figures 1; references 16: 10 Russian, 6 Western (1 in Russian translation).
[217-2415]

SPECTRAL METHOD OF CALCULATING PER-UNIT-LENGTH LOSSES IN SINGLE AND COUPLED LONGITUDINAL MICROSTRIP TRANSMISSION LINES. MODEL OF INFINITESIMALLY THIN STRIP

ZARUBANOV, V. V. and IL'INSKIY, A. S.

[Abstract] A new method is proposed for calculating losses and attenuation in longitudinal microstrip transmission lines. As the mathematical model is selected an infinitesimally thin strip between two ideally conducting shields. The solution to the corresponding homogeneous system of Maxwell equations for each characteristic region is sought in the form of longitudinally propagating normal waves. The solution is found on the basis of applicable functional relations and Leontovich boundary conditions, taking into account the linear dependence of a strong skin effect on the surface current. The algorithm involves resolving the current into its longitudinal and normal components and then expanding each into series in Chebyshev polynomials of first and second kinds, even terms representing waves with "magnetic wall" and odd terms representing waves with "electric wall". The infinite system of linear algebraic equations for the complex series coefficients is completely regular and has a normal determinant so that it can be reduced to a finite system of equations. Fast convergence is attained and few basis functions are required when the algorithm includes processing of singularities at the edges. The algorithm has been added as modification to an existing computer program for calculating losses and so tested numerically on two types of microstrip lines: single lines on suspended substrate operating over the 1-6 GHz frequency range and two coupled lines operating at the 15 GHz frequency. Figures 5; references 8: 3 Russian, 5 Western.
[217-2415]

CALCULATING TRANSIENT RADIATION FROM DIPOLE ANTENNAS ON BASIS OF INTEGRAL EQUATION IN TIME DOMAIN

LISITSYN, V. P. and PERUNOVA, V. S.

[Abstract] The problem of transient radiation from dipole antennas is solved by a new method directly in the time domain, rather than conventionally by Fourier or Laplace transformation into the frequency domain and then inverse transformation back into the time domain. A purely integral equation without derivatives of the current is constructed for this purpose, such an equation being more easily solvable by numerical methods. The procedure is demonstrated on a symmetric dipole in free space, its compound biconical surface being

generated by rotation of a broken straight line about an axis. The tangential
component of the electric field is expressed through the scalar potential of
the TM mode, a scalar potential derived from the Lorentz condition and con-
tinuous along the dipole edges. The potential difference between the two tips
of the dipole is given and the current at the tips is assumed to be zero.
Numerical calculations have been made for the far-field region of such a
dipole antenna with equal cylindrical or converging conical segments on both
ends, with a resistive load distributed arbitrarily conical segments and
hyperbolically along cylindrical segments, under excitation by a unit-step
voltage within the biconical segment. Figures 3; references 10: 5 Russian,
5 Western (1 in Russian translation).
[217-2415]

UDC 621.396.677.001.24

MAXIMUM ATTAINABLE DIRECTIVITY OF RING ANTENNA ARRAY

RYBALKO, A. M. and PAVLYUK, V. A.

[Abstract] The maximum directive gain of a ring antenna array is calculated
directly with the aid of the Jacobi-Anger series in integral-order Bessel
functions $J_n(z)$, without inversion of the mutual-impedance matrix. The maximum
attainable directivity of such an antenna, as its radius approaches zero, is
calculated with the aid of the Baily series expansion of the integral
$\frac{1}{2\pi} \int_0 |J_n(z \sin\theta)|^2 \sin\theta d\theta$. In this range the maximum directivity increases
monotonically with increasing number of radiators, while already not depending
on the optimum elevation angle and only slightly on the optimum azimuthal
angle. Figures 2; references 4: 3 Russian, 1 Western (in Russian translation).
[217-2415]

UDC 621.391

RELATION BETWEEN OPTIMUM FILTRATION AND INTERPOLATION OF RANDOM SIGNALS APPEARING WITH WHITE GAUSSIAN NOISE

SHMELEV, A. B.

[Abstract] An explicit solution to the problem of optimum interpolation for
a random signal appearing with white Gaussian noise is obtained from the known
solution to the corresponding problem of optimum filtration. Calculations are
based on the relation between the maximum-likelihood ratio and cumulant func-
tions of the aposteriori distribution characterizing the estimated process.

This eliminates the need for constructing and solving the equations of optimum interpolation, whether the signal+noise mixture is processed linearly or non-linearly. The advantage of not requiring assumptions about the statistical characteristics of estimated signals overrides the drawbacks of requiring explicit estimates and estimating the useful signal rather than its parameters. For obtaining an explicit solution to the interpolation problem, a relation is established between the transient characteristics of linear filters which yield estimates of the useful signal and interpolate these estimates respectively. The procedure is demonstrated on linear estimation of a stationary Gaussian process which has an exponential correlation function. References: 6 Russian. [217-2415]

APPLYING METHOD OF MOMENTS TO DIFFRACTION BY RIBBON

VOROB'YEV, S. N. and PROSVIRNIN, S. L.

[Abstract] The problem of diffraction of electromagnetic waves by a metal ribbon is analyzed for the case of an E-polarized incident wave beam. The scattered field is determined for the appropriate boundary conditions, which yield corresponding paired integral equations. The solution in the form of series with Bessel functions of the first kind is obtained by the method of moments. This solution, after regularization with the aid of Gauss and Hermite quadratures, satisfies the law of energy conservation regardless of the order of the symmetric coefficients matrix. The current distribution over the ribbon is subsequently determined in Chebyshev polynomials of first and second kinds. Numerical calculations have revealed that replacing the limits of integration with respect to the dimensionless variable from 0 to ∞ with 0 to 20 will result in an absolute error not larger than of the order of 10^{-6}. Figures 2; references 5: 3 Russian, 2 Western (1 in Russian translation). [217-2415]

DECOUPLING CHARACTERISTICS OF HOMOGENEOUS IMPEDANCE STRIP ON INFINITELY LARGE SHIELD

TSALIYEV, T. A. and CHERENKOV, V. S.

[Abstract] The decoupling characteristic of coating strips with edges used in transmitter and receiver antennas is analyzed in the impedance approximation rather than by the rigorous electrodynamic method. A suppression coefficient equal to the ratio of two integrals of the current amplitude squared is brought

in as the decoupling parameter. This parameter has been evaluated numerically
over a uniformly one wavelength wide region along a four wavelengths wide
homogeneous strip, either adjacent to or at various distances away from the
latter, as function of the purely reactive impedance of a lossless strip and
as function of the resistive impedance of a lossy strip. The results confirm
that decoupling is achieved only with a capacitive strip and peaks to a maximum
at the optimum capacitive reactance. They also reveal that a lossy strip pro-
vides a better decoupling, especially when the reactance is low, and that the
reactance range for effective decoupling can be widened by optimizing the
resistance. The authors thank I. M. Polishuk for assistance. Figures 3;
references: 4 Russian.
[217-2415]

MODELING OF SYMMETRIC T-MODE WAVES IN MULTICONDUCTOR MICROSTRIP LINES

LIVINENKO, L. N., POGARSKIY, S. A., SAPRYKIN, I. I. and SEDYKH, V. M.

[Abstract] Multiconductor microstrip lines are considered for microwave trans-
mission lines with desirable low characteristic impedance, such a line with n
conductors being inherently excitable in n - 1 lower-order modes. For design
and performance analysis of such lines is considered one consisting of six
conductors, two symmetric rows of three separated by a dielectric substrate
so as to form three conductor pairs and surrounded by a shielding channel of
rectangular cross-section. The electric potential distribution in such a struc-
ture is modeled on the basis of the Laplace equation with solution to the
corresponding Dirichlet problem in the form of Fourier series. The resulting
system of functional equations is not easily solvable by direct analytical or
numerical methods, owing to slow convergence of the function series. It
therefore is first transformed in accordance with the Riemann-Hilbert formal-
ism so as to become reducible to a system of linear algebraic equations of the
second kind which can be easily solved by a numerical method. Singular expan-
sion based on matrix factorization is most effective for a microstrip line
with exponentially decreasing nonuniform parameters. This is demonstrated on
a field plot of both E and H components for a symmetric quasi-T-mode wave in
such a structure with the shield connected to one row of conductors.
Figures 3; references 4: 1 Russian, 3 Western (1 in Russian translation).
[217-2415]

CONTROL OF SCATTERER SHAPE DURING SYNTHESIS

YEROKHIN, G. A. and RYVLINA, A. A.

[Abstract] The method of synthesizing energy scatterers for plane incident
electromagnetic waves on the basis of given required field structure is refined
so as to allow controlling more intricate shapes of scatterers in the synthe-
sization process. The scattered field is, for this purpose, represented as the
sum of elliptic functions. The two conditions for existence of solutions to
the problem in the form of closed ReII lines (II - complex Poynting vector),
namely energy balance on any surface around the scatterer and one component
of the scattered field an azimuthal traveling wave, must be appropriately
satisfied. Numerical calculations have been made for plane electromagnetic
waves impinging at various angles on oblate scatterers with a typical cross-
section for scattering $\sigma_0 = 0.01$ (λ - wavelength), such a cross-section being
equal to the total one of an ideally conducting circular cylinder with a
diameter 0.012λ. Figures 2; references: 3 Russian.
[217-2415]

DIFFRACTION OF ELECTROMAGNETIC WAVES AT REFLECTING ARRAY WITH DIELECTRIC COATING

KORSUNOV, V. V.

[Abstract] Methods have been developed for solution of the problem of wave
diffraction at plane reflecting arrays covered with a dielectric layer, for
both ideally reflecting, and with allowance made for finite conductivity of
the material. A solution of the problem is presented in a rigorous formula-
tion on the basis of the method of functional equations. This makes it pos-
sible to construct a numerical algorithm, which does not have a principal
limitation on the form of the surface of the array and on the ratio of the
wave length to the period. Figures 3; references 6: 3 Russian, 3 Western.
[202-6415]

PROBLEM OF SYNTHESIS OF CASSEGRAIN ANTENNA WITH OPTICAL WAVEGUIDE PROVIDING
HIGH POLARIZED DECOUPLING

KARTSOV, S. N. and POKRAS, A. M.

[Abstract] In an approximation of geometrical optics, the paper mathematically
formulates the problem of synthesis of the three reflectors of a Cassegrain
antenna with a four-reflector optical waveguide and a principal reflector of
a rigorously parabolic form used to obtain minimum cross polarization. It is
shown that the problem reduces to a system of differential equations, in
partial derivatives with functional and initial conditions. Figures 1;
references 7: 4 Russian, 3 Western.
[202-6415]

DISTRIBUTION PROPERTIES OF NACAGAMI-RICE MODEL OF SIGNAL FADING

ISKAM, V. Ya., and SHAPTSEV, V. A.

[Abstract] The results are presented of an investigation of the Nacagami-Rice
distribution, which is a more general model of signal fading than the m-
distribution and Rice models. Although the Nacagami-Rice model is more com-
plex, it has a number of advantages. It is more versatile because it includes
within itself the following models: one-sided normal, Rice, Rayleigh and
Nacagami--as particular cases during determination of the values of the param-
eters m and α_0^2. In addition, use of this model during calculation of perform-
ance in terms of error probability gives a direct connection of the quality
characteristics with the parameters of the continuous channel. Figures 1;
references 6: 5 Russian, 1 Western.
[202-6415]

CALCULATION OF PARAMETERS OF PHASE SHIFTERS WITH DIELECTRIC STRIP LINE

MURMUZHEV, B. A.

[Abstract] On the basis of the method of effective permittivity, a calculation is made of the phase shift difference introduced into the phase shifters which contain a dielectric strip line (DSL) and a dielectric or metallic plate, with a profile slot movable perpendicular to the upper surface of the DSL (shown in Figure 1 of the report). A note states that the manuscript of the article which contains 11 pages of text, 17 figures, and 5 bibliographical items, can be ordered at the TsNTI (Central Institute of Scientific-Technical Information) "Informsvyaz'" (Communication Information) where it is stored under No. 417. Figures 2.
[202-6415]

STRUCTURAL DATA MODEL FOR INTERACTIVE GRAPHICAL SYSTEMS FOR PRINTED
CIRCUIT DESIGN

ZYUZIN, Yu. V., NOVOSZHENOV, Yu. V., and OYKHMAN, Ye. G., Moscow

[Abstract] The paper proposes an approach to the consttuction of a data base
which is multipurpose with respect to problem solving for printed circuit
designs in interactive graphical systems. It is specially intended for stor-
age and editing of information concerned with the principal circuit design
(PCD), which is a basic source of data for all design problems and solution
of problems of data base organization which depends on the choice of
the mathematical model of the principal circuit. The paper proposes a new
PC which stores element identifiers and connection shape and description
addresses on a main table. When a configuration is chosen the links are stored
on a list of one of the elements in order to save machine time. The system,
unlike previous models, gives full descriptions of principal circuits,
economizes memory use and finds data rapidly. Figures 4; tables 2;
references 10: 9 Russian, 1 Western in Russian translation.
[250-6415]

PLACEMENT ALGORITHMS FOR ELECTRONIC EQUIPMENT BY SIMULATION OF THE LAY-OUT
PROCESS

EYDES, A. A., Moscow

[Abstract] The paper discusses heuristic algorithms which make it possible
at the placement stage to divide electrical circuits into fragments, distribute
the lay-out by layers, determine areas for interlayer transition, and deter-
mine the connection paths. The algorithms deal with lay-out problems for
printed circuit boards, hybrid microcircuits, etc. and made it possible to
increase the number of paths by 3-10% while reducing machine time expended on
path tracing by 2-3 times. Some constaints on computer-aided design for
certain component applications were removed. Figures 4; references 11:
5 Russian, 6 Western (1 in Russian translation).
[250-6415]

CORRESPONDENCE BETWEEN THE PARETO PRINCIPLE AND THAT OF BRINGING A SYSTEM TO
COMPARABLE FORM

YURLOV, F. F.

[Abstract] The selection of optimal solutions based on engineering, economic
or other qualitative indicators constitutes one of the most important problems
of designing complex systems. Here, the Pareto principle, which is one of the
fundamental principles of vector optimization, is used for the separation of a
multitude of incomparable systems and the elimination of the worst ones with-
out applying the conditional preference criterion. However, it is possible
that the application of the conditional preference criterion will be required
at the final stage of the synthesis. Thus, the designers of new technology,
particularly the designers of radio electronic systems encounter the problem
of reducing the ensemble of incomparable system and selecting a single optimal
solution. The development and application of principles and methods for bring-
ing the system to a comparable form is another way for the solution of this
problem. A comparative analysis was made of the two approaches in selecting
the optimal solutions. In order to realize the comparison principle with the
electronic systems, the factors for bringing the system to the comparable form
as well as the factors for ordering the alternate solutions must be separated;
the requirements in terms of the effect and the cost must be determined, and the
the vector for controlling the comparison process must be found. It is also
required that the correspondence between the possible and the required values
of the electronic system parameters are established based on the objectives of
the higher level hierarchy. Figures 2; tables 2; references: 5 Russian.
[202-12755

TOWARD A THEORY OF A DISCRETE-ANALOG SYSTEM OF AUTOMATIC GAIN CONTROL OF
RADIO RECEIVER

SHVARTSMAN, A. R.

[Abstract] A theoretical and experimental analysis of a discrete-analog
system of automatic gain control (DASAGC) of a radio receiver with a binary
control input attenuator made it possible to identify a number of character-
istics, knowledge of which plays a decisive role during realization of the
system. A regime of free oscillations, conditions of absence of generation,
the phenomenon of hysteresis, and the noise performance of a receiver with
DASAGC are considered. Quantitative evaluations are obtained and recommenda-
tions are given with respect to calculation and realization of DASAGC.
Figures 4; references: 1 Russian.
[202-6415]

TRACKING WIDE-BAND FREQUENCY MULTIPLIER

PARTALA, O. N.

[Abstract] The paper considers a frequency multiplier with Tchebyscheff
characteristics, the scope of which automatically keeps the amplitude of the
input signal. A block diagram of the frequency multiplier, data on the degree
of error, and experimental characteristics are presented. Figures 2;
references: 7 Russian.
[202-6415]

ENERGY EFFICIENCY OF RADIO-FREQUENCY AMPLIFIERS WITH TRACKING SUPPLY VOLTAGE
DURING OPERATION ON A MISMATCHED LOAD

KOL'TSOV, V. K.

[Abstract] A two-contact wide-band transistor radio-frequency amplifier
operating in a B regime is considered. It is assumed that the power delivered
by the amplifier into the load is maintained constant, independently of the
degree of mismatch. A comparison is made of the energy indices of these
amplifiers during operation on a mismatched complex load for the cases of
constant and controlled supply voltage. Automatic control of the latter in
the terminal cascades of the RF amplifiers of radio transmitting devices is
shown to be advisable. Figures 2; references 3: 2 Russian, 1 Western.
[202-6415]

SOLID STATE CIRCUITS

INVESTIGATION USING ELECTRONIC COMPUTER OF FLUCTUATION CHARACTERISTICS OF
VARACTOR FREQUENCY MULTIPLIERS WITH AN ALLOWANCE MADE FOR RECOMBINATION AND
HYSTERESIS LOSSES

MOGILEVSKAYA, L. Ya., GRINBERG, G. S., and KHOTUNTSEV, Yu. L.

[Abstract] Fluctuation characteristics of varactor frequency multipliers are
analyzed on a BSM-6 electronic computer with an allowance made for recombina-
tion and hysteresis losses in a semiconductor diode. The traditional descrip-
tion of a varactor makes it possible to take into account active losses and
generation-recombination losses in a p-n junction but not hysteresis losses.
Consequently, a charge-controlled model of a semiconductor diode was selected
as a nonlinear model, which made it possible with simplicity to take into
account the phenomena of recombination of minority carriers and hysteresis in
diodes with the effect of junction closure and diodes with charge build-up for
calculation of both energy characteristics and noise performance of frequency
multipliers. Figures 5; references 9: 8 Russian, 1 Western.
[202-6415]

MULTILEVEL SIMULATION AND OPTIMIZATION OF HIGH-SPEED BIPOLAR INTEGRATED
CIRCUITS AND LARGE INTEGRATED CIRCUITS

BUBENNIKOV, A. N., MITGASHEV, B. N. and SADOVNIKOV, A. D.

[Abstract] The paper demonstrates the possibility of multilevel through
simulation of components, elements, and large integrated circuits (LSI),
including their preparation with respect to an assigned technological route,
calculation of the electrical characteristics of components, optimization of
the high-speed response of logical elements, and analysis of fragments of LSI,
produced by contemporary technology. The following items are considered:
1) Technological simulation; 2) Program of one-dimensional technological
simulation--TEKhIS-1; 3) Physico-topological simulation; 4) Component .

simulation; 5) Macrosimulation of networks of elements and fragments of LSI; and 6) Optimization of LSI elements with respect to speed of response and power consumption. Figures 5: tables 1; references 18: 14 Russian, 4 Western. [202-6415]

MULTILAYER VOLUME MICROWAVE FILTERS

GVOZDEV, V. I., SMIRNOV, S. V. and CHERNUSHENKO, A. M.

[Abstract] Multilayer volume microwave filters are particularly suitable for miniaturization of radioelectronic devices by way of circuit integration, the principal advantage over planar filters being the much higher Q-factor: $Q_0 \geq 10^3$ as compared with $Q_0 \leq 10^2$. Their metal-dielectric structure forms an array of coupled half-wavelength resonators electrically symmetric with respect to the center layer, coupling being effected by a magnetic field normal to the plane of resonators. The structure consists of an asymmetric strip line with conductor at the input end, followed by a metal layer with cut out symmetric slot line, a dielectric layer, a symmetric strip line with conductor, a metal layer with cut out symmetric slot line, a dielectric layer, and an asymmetric strip line with conductor at the output end. The size of such a filter depends directly on the number of resonator stages and, without the case, is comparable with the size of conventional filters on symmetric strip lines only but is much smaller than that of conventional filters on asymmetric strip lines only. Its performance, particularly amplitude-frequency characteristic and coupling coefficient, has been evaluated experimentally rather than theoretically, since no three-dimensional physical or mathematical model is yet available for theoretical analysis. Data on a three-resonator filter using FLAN-10 material with a dielectric permittivity $\varepsilon_r = 9.8$ not only confirm the size and weight economy but also indicate excellent electrical characteristics. Figures 4; references: 4 Russian.
[247-2415]

MINIATURE FERRITE DIODE FOR MILLIMETRIC WAVES (3 mm BAND)

ANDREYEV, R. I., GLUSHCHENKO, A. G., KURUSHIN, Ye. P. and CHASOVNIKOVA, T. A.

[Abstract] A series of ferrite flange-diodes has been developed for milli-metric waves, specifically the 3-mm band, in the form of miniature cylinders

0.68-0.76 mm in diameter and 0.685-0.7 mm high. Prototypes of these devices were tested as cylindrical ferrite dielectric resonators with Teflon spacers in waveguide tees with matching transformer and single-step or two-step voltage transformer. The design was based on the principle of electrodynamic similarity. Their performance characteristics are VSWR = 1.1-1.4 with reverse attenuation not less than 15-28 dB and forward attenuation not more than 0.5-1.5 dB over an $f_0 \pm 2\%$ frequency band. Both reverse attenuation and VSWR remain almost constant over the -60-(+70)°C temperature range, forward attenuation is at 70°C and at -60°C respectively 0.1-0.2 dB and 0.2-0.3 dB higher than at room temperature. Figures 4; references: 5 Russian.
[232-2415]

UDC 621.372.852.2

REFLECTING MICROWAVE SWITCH BASED ON ELEMENT WITH NEGATIVE ACTIVE IMMITANCE COMPONENT

Moscow RADIOTEKHNIKA in Russian No 2, Feb 85 pp 79-81

[Annotation of article No 401, deposited at the Center of Scientific and Technical Information 'Informsvyaz'', 10 pp with 3 figures and 14 bibliographical references]

MIKHAYLOV, G. D. and GOLOVKOV, A. A.

[Abstract] A reflecting microwave switch is synthesized with a passive or active diode as switching element, which allows both control and amplification of a microwave signal with the same device. The switching element, a two-pole device, is connected as load across the output of a four-pole network. Design and performance analysis is based on a figure of merit which characterizes the contrast between ON-state and OFF-state in terms of ratios of active and reactive immitance components in both states. This figure of merit is extended to apply not only to a device with positive active immitance component but also to a device with a negative one. After invariance of this figure of merit for any stable two-pole device has been demonstrated, design and performance are optimized by maximizing the reflection coefficient. An experimental prototype of such a switch with a commercially produced IMPATT-diode confirmed the theoretically predicted high performance characteristics: maximum switching ratio approximately 30 dB and bandwidth between half-power (3 dB) points approximately 6%.
[232-2415]

PLASMA PARAMETERS AT LOW LEVEL OF INTRINSIC MICROWAVE RADIATION

KOLESNIKOV, V. N. and TISHCHENKO, Yu. G.

[Abstract] A procedure is proposed for determining the plasma parameters,
namely temperature and electron concentration as well as characteristic dimen-
sions, from its intrinsic microwave radiation at levels of the latter so low
that its power becomes comparable with or lower than the power of ambient
radiation. This is done by injecting into the plasma fine-disperse particles
with a characteristic dimension much smaller than the wavelength of that micro-
wave radiation and a melting point much higher than the plasma ion temperature,
in sufficiently small doses so that the power of their radiation will not
exceed the power of intrinsic plasma radiation. Such particles, when their
concentration is low, generate a small-scale nonuniformity of the electron
concentration distribution over the plasma volume and in such a nonhomogeneous
plasma longitudinal oscillations of the latter are linearly transformed into
transverse electromagnetic waves. These waves are emitted with a power which
peaks as their frequency approaches the plasma frequency. On this basis,
increasing the plasma radiation power by injection of fine-disperse particles
facilitates the determination of plasma parameters. The minimum plasma radia-
tion power from which the plasma parameters can still be determined is pro-
portional to the ambient temperature and to the bandwidth of the signal
receiver, but it is inversely proportional to the gain of the radiation ampli-
fier in the form of injected particles. The feasibility of such a determina-
tion was demonstrated experimentally, with fine-disperse alumina particles
(concentration 10^7 m^{-3}) in a gaseous plasma (electron concentration $3.3 \cdot 10^{16}$ m^3)
over the 1.2-1.6 GHz frequency range. Figures 2; references 7 Russian.
[217-2415]

CONDITIONS FOR EXCITATION OF HIGHER-ORDER MODES IN OROTRON ACCORDING TO
NONLINEAR MULTIFREQUENCY THEORY

SOLOV'YEV, A. N., TSEYTLIN, M. B. and BELYAVSKIY, B. A.

[Abstract] Excitation of higher-order modes in an orotron is analyzed on the
basis of the nonlinear multifrequency theory, for determining the mode starting
current more precisely than can be done on the basis of the linear theory.
The fundamental relations for a two-frequency orotron are derived from the
corresponding equation of electron motion simultaneously in both fundamental
and given higher-order modes, with given resonance frequencies and amplitude

distributions of the high-frequency field along the interaction space for both modes. The efficiency at each of the two frequencies and the starting current for the higher-order mode, normalized to the minimum starting current for the fundamental mode, are calculated from the applicable power relations. The procedure can be extended to simultaneous excitation of several higher-order modes. Figures 2; references: 2 Russian.
[217-2415]

ACTIVE MICROWAVE FILTERS

KAPILEVICH, B. Yu

[Abstract] Design principles and state-of-the-art of microwave filters employing FET, avalanche transit time diodes, Gunn diodes, varactors, or other microwave semiconductors as active elements with negative dynamic impedance were reviewed and various design approaches were examined. Three main directions in the active filter development, which include the technology, the design and modeling were outlined. It was pointed out that the technological aspects of the active filter development are now focused on finding ways of using active structures or active media for amplification or signal generation. A heterostructure of GaAs substrate with epitaxial active semiconductor n-layer and ohmic contact of AgGaIn alloy on one side of the substrate and dielectric-SiO-metal-Cr-Cu-Ni on the other side can serve as an example of such a structure. It can be used for Q-switched resonators in the two cm range. Prospects of developing monolith microwave filters with GaAs substrates are very attractive. As reported, filters in the 2-18 GHz range are built with such substrates. Design efforts continue on integrating the active elements with waveguides and resonant structures, particularly the dielectric waveguides, circular multiwave guides, or open resonators. Intensive development is observed in the area of modeling the microwave devices with active elements for computer aided design and decomposition at the electrodynamic level. The future design philosophy of the active microwave filters will depend on the success in each of the areas examined. Figures 16; references 28: 15 Russian, 13 Western.
[202-12755]

EFFECTIVENESS OF REGULATING CONSUMPTION OF ELECTRIC ENERGY EVALUATED FROM STANDPOINT OF NATIONAL ECONOMY

MIKHAYLOV, V. V., candidate of technical sciences, All-Union Scientific Research and Planning Institute of Power Industry

[Abstract] The effect of regulating the demand for electric energy on the load curve of an electric power generating system and on the depletion of energy sources is analyzed from the standpoint of national economic criteria such as capital investment and industrial budgeting policy as well as energy conservation. Depletion of energy sources, particularly fuel, is considered first. Calculations based on the classical model of a power producer system serving a power user array through a distribution network, with comparative analysis of a regulated energy market and a "free" energy market, reveal how changing the load curve affects producer and user of electric power in opposite ways at different rates so that their combined drain on energy sources also changes. They reveal that the depletion curve has a minimum and that there is a break-even point beyond which regulating the consumption becomes increasingly worthwhile from the standpoint of conservation. A similar method of analysis is applied to industrial budgeting, as the necessary means of ensuring steady national economic growth. The effect on capital investment is determined on the basis of cost analysis and here optimization is done by differentiation of the cost equation. The conclusions based on the result of these analyses are that smoothing the load curve reduces the demand for capital investment and for flexibility of power equipment so that the cost of producing electric energy becomes lower and the conditions of power plant operation improve. Regulation of energy consumption minimizes prohibitive peaks so that it improves profitability and ensures fiscal stability, which pass on from producer to user. At the same time, however, the industrial user will have to adjust to regulation in terms of production planning and production cost as well as use of standby energy sources, before the advantages of regulation in terms of lower cost of electric energy will be realized. The problem of regulation must be considered from the standpoint of overall national economy, according to a thorough systematic guide chart. Figures 5; references: 1 Russian.
[225-2415]

ECONOMIZING ELECTRIC ENERGY IN FACTORY LIGHTING IN MACHINE MANUFACTURING
ENTERPRISES

GORODYSKIY, M. V., engineer, Avtolitmash Automatic Casting Machine Mfg Plant,
MIRETSKIY, V. O., candidate of technical sciences, and MIKHAYLIV, N. I.,
candidate of technical sciences, Ivano-Frankovo Institute of Oil and Natural
Gas, and FEL'DSHTEYN, I. E.

[Abstract] Machine manufacturing enterprises spend 15-20% of all electric
energy they draw on lighting of factories. Economy measures were studied by the
Ivano-Frankovo Institute of Oil and Natural Gas and implemented at the Avtolit-
mash (Automatic Casting Machines) Manufacturing Plant, the results indicating
that savings of up to 54% can be effectively realized by: 1) replacement of
incandescent lamps with fluorescent ones, preferably with GLVD metal-halide or
DRL mercury-arc lamps, which requires a reconstruction of the lighting system;
2) voltage regulation with adequate overvoltage protection, preferably with
thyristor-type voltage limiters,which requires thorough inspection and some
modification of individual power distribution boxes; 3) remote and automatic
control with appropriate relaying and switching devices; 4) installation of
slotted luminaires in places where fire and explosion hazard exists, such lum-
inaires being now produced by the Ternopol Vatra Industrial Association;5)revi-
sion of the light switching scheme and introduction of "lengthwise-crosswise"
instead of blockwise switching, with either partial or complete cutout depending
on how little light is required during a given work shift.
[225-2415]

EXPEDIENCY OF USING STANDBY POWER FROM AUTONOMOUS PLANT IN ELECTRIC POWER
SUPPLY SYSTEM FOR ORE MINING AND ENRICHING COMBINE

SHCHUKA, Yu. V., engineer and ROD'KIN, D. I., candidate of technical sciences,
Krivoy Rog Institute of Ore Mining, and SOLOV'YEV, S. M., engineer, Donskoy
Ore Mining and Enriching Combine imeni Semicentennial of USSR

[Abstract] Electric power for the Molodezhnaya shaft of the Donskoy ore mining
and enriching combine is supplied from the regional power distribution system
through two transformers, in addition to which there are two mobile autonomous
electric power plants available as standby. A reliability analysis of this sys-
tem has been made on the basis of operating data for the 1982-83 period. A fac-
tor of primary importance taken into account here is the climate, characterized
by severe winter with the ambient temperature dropping as far as -40°C and with
up to 20°C wide diurnal fluctuations. Rules for electrical system installation
classify the region as extreme with regard to sleet and ice,considering that
ice layer up to 40 mm thick form on exposed conductors. Into account are also
taken specific fire and explosion as well as flooding hazards. Equipment in
the Molodezhnaya shaft which draws electric power includes a boiler room, two
elevators, five sump pumps, two exhaust fans, and a hospital facility. An
attendant cost analysis of equipment failure, combined with the system reli-
ability analysis, indicates that inclusion of the two PAES-2500 mobile autono-
mous standby electric power plants is justified. Figures 3; tables 1;
references: 2 Russian.
[225-2415]

SETTING OF VOLTAGE REGULATORS IN LIGHTING NETWORKS

TYUKHANOV, Yu. M., engineer, "Sibgidroproyekt" All-Union Planning, Surveying and Scientific Research Institute imeni S. Ya. Zhuk for Hydraulic Construction in Siberia, and KUNGS, Ya. A., candidate of technical sciences, Industrial Association Sibenergotsvetmet for Management of Power Systems in Siberian Nonferrous Metallurgy

[Abstract] The problem of voltage regulation in lighting networks is analyzed and solved as a statistical one, assuming a normal distribution of voltage deviations from the nominal level and a known voltage dependence of the luminous flux for given lamps. The relations established on this basis are used for setting the voltage regulators in such networks for maximum reliability of the lighting system. As an example, this is done for a 220 V network where the voltage at the terminals of the supply transformer varies normally between 246 V maximum and 218 V minimum, the corresponding mean voltage being 232 V with a standard deviation of 4.66 V. The regulator here must be set at 223 V, to ensure that the mathematical expectation of the voltage level will be 220 V and thus equal to the nominal voltage. In another 220 V network, where the voltage varies between 110% and 99% of its nominal level, the regulator must be set at 222.8 V with a voltage drop of 1% taken into ccount. Figures 1; references: 3 Russian.
[225-2415]

COMPARATIVE TECHNICAL AND ECONOMIC EVALUATION OF ELECTRIC WIRING IN FACTORIES

ZHEZHELENKO, I. V., doctor of technical sciences, Zhdanov Institute of Metallurgy, and FEDOTOV, Ye. N., engineer, Kuybyshev Polytechnic Institute imeni V. V. Kuybyshev

[Abstract] Several methods of 3-phase electric wiring in factories are compared from the combined technical and economic standpoint. Under consideration are AVVG cables and APV conductors laid in welded steel pipes or in pressurized low-density polyethylene pipes, with three sizes of type U1 perforated cleats (85, 145, 225 mm wide, two sizes of type K welded cleats (220, 400 mm wide) or size 100x50 mm^2 boxes. Unit investment cost is figured in terms of both rubles/m and rubles/(m·mm^2), whereupon the error of linearly approximating the dependence of cost per unit length on the conductor or cable size is also factored in. The underlying basic technical criterion is current loading per conductor, which determines size and number of conductors as well as their laying pattern. The results of such an evaluation indicate that installation of AVVG cables is more costly than installation of APV conductors and that using polyethylene pipes is less costly than using steel pipes. Use

of boxes instead of cleats is justified only when the number of conductors is large or when circumstances do not allow the use of cleats. Figures 2; ⠄⠄ tables 2; references: 5 Russian.
[225-2415]

SOME CONCLUSIONS FROM STUDIES ON IMPROVING RELIABILITY OF BRUSHES

LIVSHITS, P. S., candidate of technical sciences, BODROV, I. I., candidate of technical sciences, and KUBAREV, V. Ye., engineer, All-Union Scientific Research Institute of Carbon Products for Electrical Industry

[Abstract] An experimental study was made involving eight different types of nonreversible d.c. electric machine using carbon or graphite brushes with various brush holders and springs, altogether 24 General Electric machines and 57 built by the Soviet industry. Tests were performed with the appropriate number of brushes on each machine, at nominal current density in the brush and nominal peripheral velocity of the commutator. The test data have been analyzed statistically and evaluated according to applicable formulas. The results indicate that using brush holders with constant-force wound springs instead of DG or DDN brush holders commercially produced in the USSR will reduce the mean wear rate by a factor of 1.3-2.8, and that subsequently increasing the height of brushes to 80 mm from 40 mm in DB brush holders or from 60-64 mm in DDN brush holders will lengthen their service life up to 15,000 h. Figures 4; references: 8 Russian.
[225-2415]

MELTING SUBSTANCES IN ELECTRICAL MACHINES AND THEIR PROPERTIES

PETROV, V. M., candidate of technical sciences, KORKIN, V. Ye., engineer, MOTIN, E. A., candidate of technical sciences, YERSHUYEVA, S. A., engineer, TUBIS, Ya. B., candidate of technical sciences and KOVTEBA, Ye. M., engineer

[Abstract] The paper is concerned with a system of cooling electrical machines by use of the latent melting heat of working substances located within their volume. The physical properties, electrical insulation, and chemical characteristics of such melting substances are presented in a table. The investigation made of experimental specimens of electrical machines with melting substances, and the determination of the properties of these substances makes it possible accurately to select a working substance and to use it effectively. Tables 1; references 11: 10 Russian, 1 Western.
[238-6415]

VIBRATION DIAGNOSIS OF TECHNICAL STATE OF BALL BEARING UNITS OF SYNCHRONOUS
LOW-SPEED MICROMOTORS

GAYVAN, V. T., candidate of technical sciences, GUR'YEV, N. F. and
LUTCHENKO, V. G., engineers

[Abstract] The paper is concerned with experimental investigations which
establish a connection between factors which cause vibration and the technical
state of the bearing supports of PD-31 type low-speed motors. It is possible
to evaluate the technical state of ball bearings in low-speed micromotors
during operating life tests and exploitation, by conducting a spectrum analysis
of the natural vibrations of the motor. The emergence of spectral components
in the region of high frequencies and an increase of the overall vibration level
(in comparison with the original) of more than 50% indicates failure of lubrica-
tion and intense wearing away of the ball bearing elements. Exit of ball bear-
ings from operation with creeping-type and random failures takes place because
of the loss of lubricating properties and subsequent intense wearing away of
mating parts, and in the long run leads to failure of the separator. Figures 3;
references: 4 Russian.
[238-6415]

TRANSFORMER-TYPE CURRENT-LIMITING CIRCUIT BREAKERS WITH CONTROLLED
SUPERCONDUCTING SHIELDS

VERSHININ, Yu. N. doctor of technical sciences, YAKIMETS, I. V., candidate of
technical sciences, Power Engineering Institute imeni G. M. Krzhizhanovskiy

[Abstract] This paper considers the principal circuits of transformer-type
circuit breakers with controlled superconducting shields capable, together with
transformation of the voltage level, of achieving switching of power circuits
in electrical stations with simultaneous limitation of the maximum values of
the standby (avariynyy) currents. Requirements are formed for a choice of the
parameters of the basic elements: a magnetic circuit with windings; controlled
shields. It is shown that: 1) Use of controlled superconducting shields in
induction devices which unite the function of power transformers and circuit
breakers makes it possible to limit the maximum values of emergency currents;
and 2) A comparative analysis of traditional and superconducting switching
apparatus demonstrates the possibility of utilizing current-limiting trans-
former-type circuit breakers with controlled superconducting shields as one of
the measures for simplification of the circuits for generation of the energy of
power electrical stations. Figures 5; references 6: 5 Russian, 1 Western in
Russian translation.
[272-6415]

IMPEDANCE OF A MAIN DISCHARGE CHANNEL FOR LIGHTNING

KOSTENKO, M. V., Corresponding member, USSR Academy of Sciences, Leningrad Polytechnical Institute

[Abstract] A method is considered for evaluating the equivalent resistance of lightning, based on the solution of approximate, quasi-linear partial differential equations. This resistance changes within very wide limits with an increase of the lightning current at the front of the pulse. No attempt is made to develop a universal physicomathematical model of the wave processes of lightning and it is only attempted to formulate the problem and to outline the course of its solution as applied to the impact of lightning in a line of electrotransmission. The author thanks V. S. Komel'kov and B. G. Gorin for valuable critical comments expressed by them during consideration of the paper, and taken into account in the process of its completion. Figures 2; references 15 Russian.
[272-6415]

EFFECT OF LIGHTNING STROKES WHICH DO NOT PRODUCE SHORTING OF OVERHEAD LINES ON OPERATION OF CARRIER-CURRENT PROTECTION

LACHUGIN, V. F., LEVIUSH, A. I., Moscow

[Abstract] This paper considers the parameters of specific filters, selected for protection of overhead lines, not exceeding a determined length. (With an increase of the length of the line it is necessary to impose more rigid requirements on the frequency filters.) This first consideration of the problem does not take into account the effect of the filtering properties of the comparison circuit power direction relay of the reverse sequence, which at a frequency above 100 Hz already proves to be significant. With the object of a more complete consideration of all the factors, mathematical models of the relay are used, together with a mathematical model of the primary process, which is the subject of another work. As a first approximation, taking into account the presence in the measuring organs of protection, of frequency filters with a passband of 25-100 Hz, only transient components entering this band are considered. The following points are discussed: 1) Statement of problem; 2) Parameters of lightning and network; 3) Method of calculation of transient components; 4) Determination of frequencies of free oscillations ω_s; 5) Determination of location of lightning stroke, with which is observed the maximum value of free components at location of installation for protection; 6) Distribution of amplitude of first free component along the lines; and 7) Examples. Figures 5; references 11: 10 Russian, 1 nonRussian.
[272-6415]

VOLT-AMPERE CHARACTERISTICS OF LENGTHY SECTIONS OF SUPERCONDUCTOR CABLE

BENDIK, N. T., KOMISSARZHEVSKIY, N. Ye., Moscow

[Abstract] The results are presented of an investigation of the isothermic volt-ampere characteristics (VAKh) of the core of 1SPK-M cables in the range of currents from 0 to 20mA. An experimental testing unit for the 1SPK-M cable is equipped with a cryogenic helium unit which produces approximately 1 g/s of liquid helium. The VAK 12500 rectifier unit used as a current source assures a stationary current up to 12.5kA, and in a regime of short-time overloading (less than 1 second) up to 20 kA. The results are presented of an investigation of the isothermic VAKh sections of the SPK-100 test unit. The paper contains formulas which make it possible to choose an optimum rate of the linear growth of the current with which the differences of the dynamic VAKh from the isothermic are minimal. Figures 7; references 14: 7 Russian, 7 nonRussian (1 in Russian translation).
[272-6415]

THYRISTOR-TYPE STATIC COMPENSATORS FOR POWER NETWORKS AND ELECTRIC POWER SUPPLY SYSTEMS

BORTNIK, I. M., doctor of technical sciences, BURYAK, S. F., candidate of technical sciences, OL'SHVANG, M. V., candidate of technical sciences, and TARATUTA, I. P., candidate of technical sciences

[Abstract] The basic function of thyristor-type static compensators in electric power networks are compensation of reactive power and its fluctuations, symmetrization of currents after dropout of a phase, symmetrization of load and suppression of voltage flicker, limiting internal overvoltages, quenching reiterative arcs during pauses in single-phase automatic reclosure or three-phase high-speed automatic reclosure of high-voltage lines, stabilizing busbar voltages in substations during transients, and suppressing random nonsinusoidality of load currents. Each of the basic four compensator types performs several of these functions, obligatorily those it has been designed for and optionally some others. Type I compensators are installed in ultrahigh-voltage (up to 1150 kV) system mains, those of type II in 220-500 kV inter-regional or intraregional networks, and those of types III, IV in 6-10 kV user distribution lines. Compensators are built as thyristor-controlled a.c. reactors with filter circuits, as thyristor-switched capacitor banks, as combinations of both, as rectifier-inverter sets, and since recently also as polyphase inverters with forced commutation or as frequency converters.

Their performance in any of these modes is characterized and rated in terms of relative thyristor power, loss factor, number of acceptable up to 0.5 s long overvoltage surges, recovery time at 50 Hz line frequency, and response lag time after step input. Only thyristor-controlled a.c. reactors are capable of limiting overvoltages at a switch-on point. Figures 5; tables 4; references 15: 7 Russian, 6 Western (1 in Russian translation).
[246-2415]

ENERGY-OPTIMUM CURRENT DENSITY IN ELECTRIC TRANSMISSION LINE CONDUCTORS

BUDZKO, I. A., academician, "Order of Lenin" All-Union Academy of Agricultural Sciences, and LEVIN, M. S., doctor of technical sciences, Moscow Institute of Agricultural Production Engineers imeni V. P. Goryachkin

[Abstract] The problem of conductor size selection for electric transmission lines, a generally multicriterial one, is tackled from the energy standpoint. The sum of energy loss in conductors during their service life and energy of conductor manufacture is differentiated with respect to the cross-section area and equating the derivative to zero yields the current density which corresponds to the minimum total energy loss. After rounding off to nearest smaller or larger standard conductor size and establishing the current limit in each case as well as the additional energy loss resulting from nonoptimum conductor size, energy-optimum and cost-optimum current densities are traded off. This leads to a grading of conductor sizes by the method of "zoning" the environment state vectors and thus the indeterminate factor $\delta = \tau T/w_0$ (τ - length of time in which energy is lost, hours; T - length of service life, years; w_0 - specific energy of conductor manufacture, kW·h/kg). For final selection of conductor size is needed information on the parameters in this indeterminate factor, which in the case of aluminum conductor varies typically over the 250-5000 range. Figures 4; references: 14 Russian.
[246-2415]

ADVANTAGES AND FEASIBILITY OF AXIAL ELECTRIC MACHINES

KURBASOV, A. S., doctor of technical sciences, Moscow

[Abstract] The main advantage of an axial electric machine, a rotor disk between two stator disks with generally N rotor disks and N + 1 stator disks, is the theoretically higher power-to-volume ratio than in the case of radial (cylindrical) machines. This size advantage is, however, practically

realizable only for 6-pole or slower machines and not at all for 2-pole machines limited by the length of the coil ends. Further advantages of an axial construction are: absence of tooth saturation, because the magnetic flux follows a path of uniform cross-section rather than one which tapers, iron core economy with the rotor core eliminated and only the stator disks at both ends requiring iron backup for return path, better high-intensity cooling with a strong self-cooling "rotor effect" and with wider radial ducts between winding layers in the stator disks vis-à-vis narrow axial air gaps, and reduction of both iron and copper losses by more efficient magnetic and electric loading, with smaller magnetizing current or smaller leakage reactance. The feasibility of building an axial electric machine depends on the solution of a few technological problems. One major problem is slotting and winding the two stator disks with backup iron at the two ends of the machine. Another major problem is assembling and fastening all stator disks with maintenance of narrow air gaps between them and the rotor disks. A prototype axial synchronous motor for a 2000 kW cascade drive is now being developed at the Novocherkassk Electric Locomotive Manufacturing Plant in accordance with the author's design. Possible applications for such electric machines, a.c. machines specifically, are not only general industrial ones but also special ones such as water-turbine generators. An interesting concept is an automobile motor-wheel, with the wheel rim acting as squirrel-cage rotor and the stator winding on a stationary intermediate disk, which would eliminate speed-reducing gears. Figures 6.
[246-2415]

UDC 621.31:061.3

EIGHTH INTERNATIONAL CONFERENCE ON USE OF COMPUTER TECHNIQUES IN ELECTRICAL POWER ENGINEERING

AVETISYAN, D. A., doctor of technical sciences

[Abstract] The 8th Triennial International PSCC Conference, according to the 1963 agreement between the United States, the USSR, the FRG, England, France, Italy and Sweden, was held on 19-24 August 1984 in Helsinki (Finland). The theme of the conference was use of computers in electrical power engineering. Reports and discussions on problems and methods of planning and designing electric power systems dealt with structural-parametric synthesis and functional-parametric synthesis, total thermal-electric system approach, optimization formalism, reliability estimation, nondepleting new energy sources, and engineering-technological design. Reports and discussions on problems and methods of control dealt with computer-aided operation and performance analysis, theoretical and practical performance evaluation by second-order methods in rectangular coordinates, performance optimization by control in real time, optimization of steady and transient processes by nonlinear programming and relaxation methods, and optimization of reactive power using biological evolution as model which ensures convergence under various physical constraints. Reports and discussions on problems and methods of modeling and simulation dealt with linear and nonlinear finite equations as steady-state

models, discrete analogs of differential equations as transient-state models, simplification of models and identification of parameters, and digital simulation. An overview of the conference proceedings reveals that much progress has been made in use of computers for structural-parametric synthesis of large electric power systems and use of microprocessors for their control, also a strong trend toward simple models and digital simulation. At the same time, the conference did not adequately cover computer-aided engineering-technological design and problem solution for small electric power systems. The level of theoretical research on computer application to electric power systems is about the same in the Soviet Union as in the rest of the world. [246-2415]

ELECTRIC FIELD IN NONHOMOGENEOUS THIN FILMS

SKVORTSOV, B. V., candidate of technical sciences

[Abstract] A thin conductor film, inevitably nonhomogeneous because of technological imprecision, is considered under a constant voltage applicable across two electrodes. The electric field distribution in such a film is determined on the basis of the corresponding two-dimensional steady-state partial differential equation, this equation having been derived from the two applicable field equations div $J = -Q$, $E = -\text{grad } \emptyset$ and Ohm's law $J = \sigma E$ (J - current density in film, Q - density of drain or source current, σ - electrical conductivity of film material, $\emptyset$ - electric potential, E - electric field intensity). The electric field distribution is assumed not to depend on the film thickness and the latter to be much smaller than the other film dimensions. Zero normal component of the current density is the boundary condition and the two electrode potentials serve as initial conditions. The equation is solved by the method of finite differences with Liebmann iteration. The arbitrary film geometry is replaced with an equivalent rectangular one so as to avoid satisfying the Neumann conditions at curvilinear boundaries, which is permissible in the usual case of a rectangular substrate of a nonconducting material. The algorithm for each of the resulting four partial regions has been programmed in FORTRAN-4 for a YeS-1022 or YeS-1033 digital computer. Figures 2; references 6: 4 Russian, 2 Western (both in Russian translation). [246-2415]

LAWS OF POWER CONSERVATION IN ELECTROMAGNETIC FIELD

GOVORKOV, V. A., Moscow

[Abstract] The law of energy conservation in an electromagnetic field is reconstituted so as to apply to average power, ratio of the energy change during a finite period of time to the length of that period, considering that this

quantity is measurable while absolute energy is not. The analysis is based on the two applicable Maxwell equations, for curls of the field components, their product yielding a generalized equation of balance for the electrodynamic quantities and particularly power. The results are applied to two fundamental situations. In the first case a field is replaced with a lossless linear one-port network, specifically a two-pole one, for determination of its resonance characteristics. The second case is superposition of power from two different field sources, a "voltage generator" and a "current generator" capable of maintaining a constant magnitude of electric field intensity and magnetic field intensity, respectively, at the load regardless of the system performance characteristics and the input power level. Figures 3; references 5: 4 Russian, 1 Western (in Russian translation).
[246-2415]

INTERNATIONAL SCIENTIFIC COLLOQUIUM IN GERMAN DEMOCRATIC REPUBLIC

VALOV, B. M.

[Abstract] The 28th International Scientific Colloquium was held in October 1983 in Ilmenau (GDR), with 175 foreign specialists from 15 countries among the approximately 1000 participants. The subsection "Industrial Facilities and Installation of Electrical Equipment for Transmission of Electric Energy" dealt with such topics as electrical apparatus of the future, multifunctional static voltage and current correcting devices, optimization of polyphase transmission lines, space and material economy in design of transformer substations, current-voltage relations in a.c. networks with electric-arc furnaces, methods of calculating thermal and mechanical effects in sheaths around 3-$\emptyset$ busbars, universal mathematical model of nonlinear electrical receiver for analysis of rectifier processes, special ripple and kvar attenuating devices for electric and electronic power drives, hybrid analog-digital instrument for monitoring and accurate measurement of harmonics in electric power circuits, and quality control of electric energy in power networks. Specialists from West Germany participated in the proceedings of this subsection along with specialists from East Germany and the Soviet Union.
[229-2415]

NEW SERIES OF TRANSFORMERS FOR SUBMERSIBLE ELECTRICAL PETROLEUM MOTOR-PUMP SETS

GENDEL'MAN, G. A., candidate of technical sciences, Experimental Design Office
for construction, study and installation of rodless deep-well pumps,
MALAKHOV, I. S., engineer, State Committee for Supply of Material and Equipment
at USSR Council of Ministers, KOSHCHEYEV, A. A., engineer, USSR Ministry of
Petroleum Industry, GOL'BERG, G. Ye., engineer, Minsk Electrical Equipment
Manufacturing Plant, and SHVARTS, D. L., engineer, Special Design Engineering
and Technological Office for submersible electrical well drilling and petroleum
extracting equipment

[Abstract] In most petroleum drilling rigs the submersible electrical motor-
pump sets are energized from a common 6(10)/0.4 kV 3-∅ oil-filled step-down
power transformer through 0.4/1-2.2 kV oil-filled special step-up transformers,
a separate one for each pump motor matching the size and the rating of the
latter. The existing TMPN-73 25-250 kVA transformer series has become inade-
quate for present needs, mainly on account of excessive energy losses and
excessive equipment cost associated with either two stages of voltage trans-
formation or three windings on a single transformer. In addition, every change
of motor-pump size requires a corresponding change of transformer size. The
new TMPN-82 series, developed to replace the old one, features a wide-range
voltage regulation and thus eliminates these problems. A transformer of this
series has a high-voltage winding and a low-voltage winding, the latter con-
sisting of two electrically isolated coils and the former tapped for a sliding
regulator switch. Voltage regulation on the high-voltage side within one step
of low voltage is uniformly smooth, inasmuch as the numbers of turns in succes-
sive winding segments follow a geometric progression so that a constant voltage
ratio from step to step is maintained throughout the entire range. The number
of regulation steps is m = (n + 1)(k + 1)(n,k - numbers of segments in primary
winding and secondary winding respectively). The transformers of the new
series have also been designed for optimum productivity and economy, with
installation and maintenance cost as well as depreciation and replacement cost
taken into account. Figures 1; tables 3.
[229-2415]

CONCERNING A NEW VOLTAGE LEVEL FOR A.C. NETWORKS

YERSHEVICH, V. V., candidate of technical sciences, Moscow

[Abstract] An analysis of the conditions of development of the Unified Power
System of the USSR (YeES SSSR) at present showed that the power transmission
of alternating current voltages now in use solves all the real problems of

the necessary increase of the basic YeES network up to the end of the present century. However, two questions are important: 1) Is it necessary to develop a new, still higher voltage level, and 2) When and for what use is the introduction of the first power transmission of this voltage. The present paper studies the advisability and dates of such an introduction. The following specific items are discussed: 1) General considerations; 2) Necessary carrying capacity of basic YeES SSSR; 3) System-generating lines; and 4) General evaluation of use of new voltage lines. It is concluded: 1) At the beginning of the next century prerequisites will be created in the YeES SSSR for a sufficiently wide use of lines for power transmission of alternating current of a new voltage level; 2) Desirable values of the principal parameters of the new lines, on which it is necessary to orient during development: rated voltage -- 2,000 kV, carrying capacity -- 20 GW; 3) Principal function of lines for new voltage level -- distribution of power of large-scale complexes of power stations in areas of electrical power consumption at distances up to 2.5-3 thousand kilometers, and an increase of the system-generation of the YeES SSSR network in the direction South-Center-Urals-Siberia up to 4-5 thousand kilometers; and 4) A definite solution concerning the advisability and dates of introduction of a new A.C. voltage level can only be made after an investigation conducted with great care of an alternative version -- extensive use of direct current in the form of individual power transmission of networks. It is necessary to conduct scientific-research work with respect to both versions. Figures 6; tables 1; references: 7 Russian.
[218-6415]

UDC 621.311.001.2.577.47

ASSESSMENT OF DESIGN VERSION FOR POWER NETWORKS AS CONCERNS EFFECT ON THE ENVIRONMENT

KUZ'MIN, Ya. F., candidate of technical sciences, and ARUMS, A. S., engineer, Rizhskiy Polytechnical Institute

[Abstract] A method is presented which makes it possible during the design of power networks to describe the effect of such networks on the environment. From the position of the theory of systems, an electric power system is a dynamic system with causal-investigation relationships. The principal goal of this paper is to reveal design versions of power networks which effect the environment in a minimum way. In order to realize an "entire" circuit, it is considered as consisting of a great number of subsystems or criteria. In the present instance such criteria as minimum damage to agriculture, and minimum acoustic effect, are used. Figures 3; tables 1; references 7: 6 Russian, 1 Western.
[218-6415]

CONCERNING MODELLING OF ARC-SUPPRESSION CHAMBERS HAVING LONGITUDINAL BLOW-OUT

VISHNEVSKIY, Yu. I., IGNAT'YEVA, L. Ye., KRIZHANSKIY, S. M., and YANOVA, T. V., Leningrad

[Abstract] In a 1983 paper by S. M. Krizhanskiy (see above), dimensionless and dimensional complexes are considered as well as scale factors, providing similarity of processes of arc-suppression under full-scale and model conditions. This makes it possible to conduct experiments concerned with an investigation of arc-suppression on reduced models and small-power units. The present work provides direct development of the Krizhanskiy paper using the same nomenclature, and the results are set forth of experiments concerned with arc-suppression on models of various dimensions and under similar conditions, and their generalization in dimensional complexes. Figures 1; references 12: 9 Russian, 3 Western (1 in Russian translation).
[218-6415]

ELECTROMAGNETIC FIELD CALCULATION BY EQUIVALENT SOURCE METHOD

BYSTROV, Yu. A., Doctor of Engineering Sciences Professor, DMITRIYEV, A. V., docent, candidate of Engineering Sciences and ZAGRANICHNYY, Ye. N., candidate of Engineering Sciences, Leningrad Electrotechnical Institute imeni V. I. Ul'yanov (Lenin).

[Abstract] A method proposed elsewhere by the authors for calculating the electromagnetic field in the vicinity of a thin ring about which eddy currents flow is extended to bulk conductors residing in an assigned electromagnetic field and serving as the basic elements of electric power devices and systems for monitoring their parameters. The density of the equivalent sources is found for the field vectors with the help of boundary conditions. By arranging these sources on a surface constructed in the dielectric medium that follows the configuration of the conductor, the resultant field in its vicinity can be found by numerical integration of Fredholm equations of the second kind. The proposed method is similar to the 'secondary source' method, but the solution is structured differently: an analytical model is developed in which the equation is solved iteratively. The equivalent source method can be used to determine numerically the high frequency fields of most electrode systems encountered in electrical and electronic devices. References: 5 Russian.
[230-6900]

ANALYSIS OF FEASIBILITY OF POWER SYSTEM RELIABILITY LEVEL

LOSEV, E. A., candidate of Engineering Sciences, VNII Proyektelektromontezh.

[Abstract] An evaluation criterion for the feasibility of the reliability level of power systems proposed elsewhere by the author is investigated quantitatively, and its effectiveness is analyzed. The proposed measure is the quantity $\alpha = U:Z$, where U represents unexpected power outages, and Z represents the minimum adjusted cost. The analysis indicates that the hypotheses regarding the existence of the criterion α, as well as its quantitative value, are incontrovertible. Competing versions of power systems are evaluated using the proposed criterion. The value of the criterion is found to depend strongly upon the relative loss. The characteristics of the reliability level feasibility criterion and the technical and economic indicators of the reliability level of competing power system versions are tabulated. References: 7 Russian.
[230-6900]

INDIRECT METHODS FOR ESTIMATING CERTAIN SOLAR RADIATION PARAMETERS NEEDED IN DETERMINING OUTPUT OF SOLAR INSTALLATIONS

KANTAN, V. V., docent, candidate of Engineering Sciences and KHAMUD, Yu. M., Leningrad Polytechnical Institute imeni M. I. Kalinin.

[Abstract] This study describes the use of cloud cover observations to obtain a sufficiently accurate representation of the total solar radiation distribution in a region of interest in order to determine the amount of energy that can be produced by various solar installations. The results of measurements taken over six years at eight points in northwest Africa are analyzed in order to select the relationship between total radiation and degree of cloud cover that corresponds best to the climate conditions in question. The smallest deviations from the true values are obtained by Berland's formula. The correlation between the ratio of the scattered energy to the total incident energy and the indicator that characterizes the total attenuation of radiation in the atmosphere is found. It is shown that the average monthly cloud cover at each point is the only meteorological parameter that must be known in order to calculate the solar radiation parameters necessary for developing solar installations. References 2: 1 Russian, 1 Western.
[230-6900]

TRAINING OF HEAT POWER ENGINEERS ON ELECTRICAL PART OF ELECTRIC POWER PLANTS

SYABER, N. A., GREKALO, N. Ye., Doctor of Engineering Sciences, SIN'KOV, V. M.
and BUKHAN, B. D., Kievenergo

[Abstract] This article discusses the need for making heat engineers aware of
the basic issues encountered in connection with power engineering, and educa-
ting them as to the general principle by which electrical engineering problems
are solved, but without delving into the details of special problems that are
within the purview of electrical engineering specialists. The qualifications
of heat power engineers must therefore include, under the heading of special
disciplines, knowledge of basic and auxiliary power equipment, as well as the
fundamentals of electrical engineering. Inasmuch as new graduates exhibit
neither the required breadth nor depth of knowledge about the electrical part
of power plants, a course on the electrical equipment of heat and power plants
is described. The course program covers basic equipment, electrical circuits,
relay protection and automatic emergency equipment, inter alia. This program
is reviewed in detail, and some revisions are proposed in order to fill a
number of gaps.
[230-6900]

ELECTRICAL INSULATION

ANALYSIS OF TRANSIENTS IN DIRECT CURRENT CABLE INSULATION

SHUVALOV, M. Yu., engineer, GLEYZER, S. Ye., candidate of technical sciences, and LARINA, E. T., candidate of technical sciences

[Abstract] This paper, which is heavily based on nonSoviet references, thoroughly analyzes the physical phenomena originating in the impregnated oil-paper insulation of a DC cable with the changes applied to it by voltage. A mathematical model of transients is proposed which uses an operational calculas method. The concept of complete operational resistance of insulation is introduced. Formulas are presented which make it possible to determine the distribution of the electrical field in the insulation at any moment of time. As an application of the theoretical results obtained, problems of testing DC currents are considered. It is concluded that if in a steady-state region the electrical field intensity in the DC cable insulation is distributed according to resistance, then in the transient process the image of the intensity is distributed according to the operational resistance. Figures 3; references 9: 5 Russian, 4 nonRussian.
[272-6415]

INFLUENCE OF STORAGE CONDITIONS AND OPERATIONAL FACTORS ON ELECTRICAL CHARACTERISTICS OF POLYMER INSULATION IN GEOPHYSICAL CABLES

MESENZHNIK, Ya. Z., YEREMEYEV, G. V., PRUT, L. Ya., and TYAN, I. S., Tashkent

[Abstract] The effect is investigated of prolonged atmospheric aging and the subsequent multicycle mechanical loading, on the change of the electrical characteristics of polymer insulations widely applied in the construction of domestic and foreign geophysical cables. Consideration is given to a number of marks of domestic geophysical cables, exposed over the course of 10 years to the open air under the conditions of the hot and dry climate of the city of Tashkent, which with respect to the number of sunny days with a high tempera-ture of the air is close to the climate of a number of countries (Iran, Iraq

and others), in which the largest petroleum regimes of the world are located. Because the processes of photo and thermal aging in the open can play a predominate role in the change of the polymer properties, one can expect that it is possible to extend the laws obtained during investigation of aging in the climatic conditions considered to the regions designated above. The data presented with respect to the change of the electrical characteristics of the polymer insulation of geophysical cables under the influence of the factors considered can be used during construction of these cables, with the object of forecasting both their storage under the conditions of a number of the largest petroleum regions of the world, and the subsequent full operating time. Tables 3; references 16: 13 Russian, 3 nonRussian
[272-6415]

ANALYTICAL DESCRIPTION OF THE PERMITTIVITY OF POLYETHYLENE FOAM INSULATION

YERMURATSKIY, P. V., candidate of technical sciences, USKOV, A. V., Moscow Institute of Fine Chemical Technology

[Abstract] Determination of the parameters of heterogenous media (mixtures) on the basis of a study of the properties of pure components, the compensation and structure of a mixture, are constantly found in the field of view of this investigation. Various structures lead to different mathematical models. On the basis of experimental data from a 1984 paper by L. N. Stolbovoy (Relative Permittivity of Polyethylene Foam Insulation), the present paper verifies the adequacy of various models of mixtures, and investigates the field of possible values of the parameters, which are presented in a table. It is concluded that: 1) It is possible there are a large number of different descriptions of the properties of polyethylene foam, considered both as isotropic and anisotropic structures, which are not in conflict with experimental data; 2) Model [1] establishes a sufficiently wide confidence region which testifies concerning inaccurate finding of parameters; and 3) An isotropic model with an ellipsoidal included kind of plane spheroids gives the minimum confidence region. Figures 4; tables 1; references: 5 Russian.
[272-6415]

ENERGY ABSORBED DURING INTERACTION OF FUSION NEUTRONS AND ELECTRICAL
INSULATION MATERIALS

MASLOV, V. V., candidate of technical sciences, All-Union Scientific Research
Institute of Electrical Insulation Materials

[Abstract] Synthesis of deuterium and tritium is the most promising reaction
from the standpoint of technical feasibility in a fusion reactor. Up to 25%
of all neutrons released in this reaction are at the 14.1 MeV energy level.
An important engineering problem is, therefore, to determine the amount of
energy absorbed by electrical insulation materials and systems upon their
bombardment by such neutrons. The analysis of this problem must necessarily
include all possible modes of interaction between nuclei of insulation material
elements and the absorbed neutron radiation dose. These are: elastic scattering
by nuclei (n,n reaction), elastic scattering by protons (hydrogen nuclei),
inelastic scattering by nuclei (n,n' reaction), secondary emission of neutrons
(n,kn reactions with k = 2,3,...successively less probable), secondary emission
of charged particles (n,p and n,o reactions), and secondary emission of -quanta
(n, reaction) upon inelastic scattering and capture of thermal neutrons. The
energy absorbed in each case is found by using the appropriate formulas and
available data on neutron fluence in fusion reactors as well as on the scatter-
ing cross-sections of insulation material elements and their isotopes. Pre-
liminary calculations indicate that only elastic and inelastic scattering in
organic materials and only inelastic scattering in inorganic materials without
hydrogen nuclei needs to be considered for engineering purposes. Calculations
made for insulation tape consisting of glass and mica fibers with epoxy binder
and used on superconductor coils in an INTOP tokamak reactor yield and absorbed
radiation dose of approximately $1 \cdot 10^7$ g·R, well below the $1 \cdot 10^9$ g·R maximum
allowable level and thus safe for this "monolit" electrical insulation system.
Figures 2; tables 4; references 13: 12 Russian, 1 Western.
[246-2415]

TRANSPORTATION

THEORY AND DESIGN OF TRACTION DRIVE FOR ELECTRIC AUTOMOBILES BY I. S. YEFREMOV,
A. P. PROLYGIN, YU., ANDREYEV, A. B. MINDLIN (IZD-VO VYSSHAYA SHKOLA,
MOSCOW 1984): BOOK REVIEW

IN'KOV, Yu. M., professor, and ISAYEV, I. P., professor

[Abstract] The book is written for students at higher educational institu-
tions but will be also useful to engineers and scientists specializing in
development of electric drives for cars and trucks. It contains ten chapters
dealing successively with classification of automobiles and drives, analysis
of vehicular power plants and calculation of their characteristics, theory and
design of electric traction generators and motors, static electric energy con-
verters such as frequency converters, design optimization, automatic control
of automobile operation, and evaluation of existing electric traction drives
for electric automobiles built in the Soviet Union, with concluding recommenda-
tions. The book is well organized and the material is well presented, although
not all topics are treated at the same scientific level and neither reliability
nor economic indicators are dealt with at all. There are also a few errors
to be found, in substance (rectifier groups in a direct-action converter pro-
duce not voltage but current half-waves) and in terminology) power transfer
should be energy transfer), while too many abbreviations make it difficult to
follow the text.
[246-2415]

ELECTROMAGNETIC COMPATIBILITY

MODEL FOR ANALYSIS OF ELECTROMAGNETIC FACILITY FOR LIMITED TERRITORY

IVANOV, V. A.

[Abstract] The problem of electromagnetic compatibility is tackled for a radio
receiver in a territory within the range of several radio transmitters in a
configuration which can be either favorable or unfavorable with respect to
interference reception. For determining whether the configuration of the total
facility is favorable or not, a mathematical model of it is proposed which
describes both frequency and amplitude characteristics of the interference
pattern. Frequency-dependent interference overshoots are approximated as tri-
angular or trapezoidal pulses, or combinations of both, whereupon the necessary
relations are given in closed analytical form closely approximating experi-
mental curves. These relations, operated on according to the methods of dif-
ferential calculus, yield frequencies and frequency bands unsafe in the inter-
ference sense relative to both linear and nonlinear parts of the radio
receiver. Figures 3; references: 5 Russian.
[232-2415]

COMPONENTS, HYBRIDS AND MANUFACTURING TECHNOLOGY

LASER TECHNOLOGY IN MANUFACTURE OF PRINTED-CIRCUIT BOARDS

MACHULKA, G. A., STEL'MAKH, M. F. and ULADINOV, A. B.

[Abstract] The complexity of the printed-circuit board manufacturing process, additionally encumbered by the intricacy of topology and layout, especially in multilayer boards, makes application of laser technology a very attractive possibility. Extensive studies have established the feasibility of using laser radiation in polygraphic dry offset printing, despite difficulties created by the high thermal conductivity of metallized surfaces, also in etching of patterns, drilling of holes, and soldering of joints. A gaseous (CO_2) laser and a solid-state (garnet) laser have been found to be most suitable, each for specific operations. One of the most critical factors here is selection of oxidation-resistant materials for masks and insulation. The next step is incorporating the laser operations in the production line. The feasibility of this has been established in three versions. The first and simplest version, without computer, is proposed for experimental or pilot production of bilateral boards. The second version is proposed for commercial production, with an automatic work station and a control computer. In the third and most advanced version, for large-scale production, the automatic work station has been replaced by a computer-aided design system. Automatic laser etching alone can save 70,000 rubles annually by shortening the technological cycle and better economy of materials, while by elimination of photoresist alone it can save more than 500,000 rubles annually in commercial production. The authors thank Candidate of Technical Sciences N. V. Markova, Engineer Ye. Ts. Braslavskiy, and Engineer V. S. Kovrizhkin for making available the results of their studies of offset printing, laser soldering, and laser drilling respectively. Figures 5; references: 6 Russian.
[232-2415]

WAYS TO REDUCE TECHNOLOGICAL CONSUMPTION OF ENERGY IN ELECTROLYTIC COPPER
REFINING PROCESS

PUZAKOV, V. V., candidate of chemical sciences, and ZAUZOLKOV, I. V.,
candidate of chemical sciences, Ural Scientific Research and Planning Institute
of Copper Industry, ZAGORODNIKOV, N. P., engineer, "Uralelektromed'" (Ural
Electrolytic Copper) combine, and MELOYAN, R. G., candidate of technical
sciences, Armenian Pedagogical Institute imeni Kh. Abovyan

[Abstract] Electrolytic refining of copper is analyzed in terms of voltage
and energy relations according to Faraday's law. These relations, which take
into account anodic and cathodic polarization as well as all contacts and
voltage drops in the trough, indicate the ways in which the energy of electrol-
ysis can be reduced. The most significant factors affecting the energy bal-
ance are composition of the electrolyte, cathode current density, and the
Whitehead contact. They can be quantitatively optimized and matched for
minimum energy consumption, as has been confirmed by statistical data. Proper
cleaning and lubrication of contacts is desirable and can be mechanized.
Figures 1; references 4: 2 Russian, 1 Polish, 1 Western.
[229-2415]

RELIABILITY OF ELECTRICAL EQUIPMENT IN PETROLEUM AND NATURAL GAS INDUSTRY

POKONOV, N. Z.

[Abstract] An extended scientific-technical conference was held in December 1983 in Moscow by the Power Engineering Section of the Central Board of the Petroleum and Natural Gas Scientific-Industrial Association imeni I. M. Gubkin. The subject was reliability of electrical equipment operating in this industry. Reports and discussions dealt with problems of reliability improvement, specifically installation of STD and STDP synchronous motors in water and oil pumping stations, SDBO-99/49-8KhL2 synchronous motors for well drills, KTPPN-82 and KUPNA-500/700/800 motor generator sets, ShGS-5803 solid-state controls for submerged drives, SDB brushless synchronous motors and BUS-3M thyristor-controlled induction motors, better station and rig lighting, STD-125000 high-voltage synchronous motors for 10 kV charger-distributor and compressor-distributor sets in gas pumping stations, 35 kV seabed cables for offshore drill rigs, a 25 MW gas motor-pump set with thyristor starting and control, 4-12.5 kW electric compressor drives, 35-110 kV transformers and 6-10 kV distributors for operation at ambient temperatures of -45°C or lower. Deficiencies in implementation of the reliability improvement program were also reported, most serious among them being slow overhaul of the "Monolit-2" winding insulation system. On the basis of these reports, three sets of recommendations were addressed to the Ministries of Electrical Industry, Construction Industry, and Petroleum Industry respectively. They pertain to specific tasks aimed at a more expeditious implementation of the program. [229-2415]

MAGNETICS

PROSPECTS FOR DEVELOPMENT OF MATERIALS FOR PERMANENT MAGNETS

LINETSKIY, Ya. L., candidate of physico-mathematical sciences, and SERGEYEV, V. V., candidate of technical sciences

[Abstract] The technology developed and the production capacity set up in the USSR during the last 10-15 years for magnetosolid materials with a wide range of magnetic properties and technological characteristics are briefly reviewed. An evaluation is made of the maximum worldwide level of the properties of highly coercive materials, the attained level of the properties is shown, and new technological processes are described. The magnetic properties of iron-cobalt-chrome alloys (contents in alloy, %, and magnetic parameters), and the properties of Mn-Al-C alloys (parameters, theoretical values, maximum obtained values, and guaranteed properties [isotropic magnets, anisotropic magnets, anisotropic type of "light density"] are shown in tables. It is concluded: 1) That the principal prospects for improvement of the magnetic properties of known groups of magnetosolid materials must be connected with improvement of their production technology; 2) Development is possible of materials with an average level of energy $(BM)_{max/2} = 40$ Kjoule/m^3, not containing deficient expensive materials; and 3) A considerable increase of magnetic energy (more than 180 Kjoule/m^3) after the introduction of new intermediate phases with high fundamental magnetic properties. Tables 2; references: 8 Western, in Russian translation.
[238-6415]

EFFECT OF PULSE FORM ON MAGNETIZATION OF RARE EARTH-COBALT MAGNETS

NESTERIN, V. A., candidate of technical sciences and OKOPNIK, Ye. B., engineer, VNIIR (expansion unknown)

[Abstract] The paper is devoted to calculation and analysis of the penetration of a pulse magnetic field into a long cylindrical specimen of a permanent magnet of rare earth-cobalt material during alteration of the relation between

the total duration of the pulse and the duration of the front. The following
assumptions were made during the calculations: 1) The field without the cylin-
drical magnet specimen is homogeneous and directed parallel to its axis; 2) The
material of the permanent magnet is homogeneous with respect to its electrical
and magnetic properties (because the presence only of the axial components of
an anisotropy field do not exert an effect on the magnetization process); and
3) The displacement currents within the specimen are disregarded with allow-
ance made for high conductivity of the material and the concrete millisecond
range of duration of the magnetizing pulse. Figures 4; references 5:
4 Russian, 1 Western.
[238-6415]

DOMAIN-WALL DISPLACEMENT WAVES IN FERRITE PLATE

VYZULIN, S. A., KIROV, S. A. and SYR'YEV, N. Ye.

[Abstract] For application of magnetic materials with domain structure in
magnetostatic-wave devices, domain-wall displacement waves are examined which
belong in the range of long ones relative to the period of the domain struc-
ture. A cubic magnetic material with a negative anisotropy constant is con-
sidered, a plate of such ferrite cut in the (110)-plane and having a two-phase
lamellar structure with domain walls perpendicular to the magnetizing field
$H_0 \parallel$ [110] as well as to the magnetization vectors M_1, M_2 in the plane of the
plate at different angles to the domain walls. The relation between alter-
nating magnetization and magnetic field intensity, both averaged over the
structure, is evaluated for high-frequency magnetostatic waves under which
elastic elongation of domain walls and demagnetization caused by sloping of the
domain walls become negligible in comparison with the Zeeman magnetization
energy. The results of calculations agree within an order of magnitude with
experimental data on YIG (yttrium-iron garnet) plates. They also indicate
that such domain-wall displacement waves can be only forward volume waves,
their number being infinite with different normal wave number. Waves propa-
gating in the plane of the plate cause bending of domain walls across the plate
thickness. In a tangentially magnetized plate these waves have group veloci-
ties of the same order of magnitude as those of Damon-Eshbach waves, but their
frequencies are much lower and of the order of 100 MHz. Figures 2;
references 6: 2 Russian, 4 Western.
[217-2415]

CRITICAL CURRENT STARTING FORMATION OF THIN-FILM METAL-DIELECTRIC-METAL
CATHODE

BARENGOL'TS, Yu. A.

[Abstract] The critical current for starting formation of a thin-film metal-
dielectric-metal cathode, by melting or bursting of microasperities on a metal
electrode as a result of Joule-effect heating, is calculated on the basis of
the autoelectronic emission mechanism in a single conduction channel. Into
consideration are taken the high electric field intensity, indicating a tunnel
injection of charge carriers into the dielectric layer, as well as the energy
barrier at the metal-dielectric boundary and modulation of the energy bands of
the amorphous dielectric by a random potential with zero mean value. Numerical
results for metal-Si_3N_4 barriers (metal: Al, Cu, or Au with work functions of
4.25, 4.51, and 5.22 eV respectively) and a Debye shielding radius of 50 Å
indicate that the tunneling current may have to reach 10^5 A/cm^2. The author
thanks Yu. B. Yankelevich for discussion of the results. Figures 3;
references 11: 6 Russian, 5 Western (4 in Russian translation).
[217-2415]

SPECIAL FEATURES OF OPERATION OF VOLTAGE INVERTER CONTROL SYSTEM WITH
TRACKING

MANUKOVSKIY, Yu. M.

[Abstract] The paper describes a servo control system (SCS) consisting of 153
and 511 series integrated microcircuits, and used for control of a three-phase
transistor voltage inverter. Tests showed that the SCS provides high pre-
cision formation of the sinusoidal curve of the output current of conversion--
the load current does not exceed 5% over the entire control range. Figures 4;
references: 8 Russian.
[251-6415]

METHOD OF COMPLEX EVALUATION OF PHOTOELECTRIC AUTOCOLLIMATORS

TITOV, V. S. and YAKUSHENKOV, Yu. F., Avtayskiy Polytechnical Institute, Moscow Institute of Geodesia, Aerial Photography and Cartography

[Abstract] The autocollimation method (ACM) is one of the prevailing optical methods of angular measurements. Use of photoelectric autocollimators (PACM) makes it possible to automate the measurement process which in its turn increases the precision of measurements, and widens the field of application of the ACM. Although a sufficiently large number of PACM designs have been developed in the USSR and abroad, choice of the optimum scheme of design for solution of concrete problems is often difficult because of the impossibility of a well-defined evaluation of an autocollimator with respect to one or two parameters. The present paper describes one of the possible methods of approximate evaluation, and a comparative evaluation is made of PACMs, with respect to certain major parameters. The paper is recommended by the Department of Electrical Technology, Altayskiy Polytechnical Institute. Tables 2; references: 4 Russian.
[252-6415]

PROCEDURE FOR CALCULATING ATTENUATION IN AND RELIABILITY OF ATMOSPHERIC
OPTICAL DATA TRANSMISSION SYSTEMS

MILYUTIN, Ye. R. and YAREMENKO, Yu. I.

[Abstract] A procedure is developed for calculating the energy characteristics
and the reliability of atmospheric data transmission systems operating in the
optical range. The principal energy characteristic is the energy loss, which
determines the signal attenuation in the optical channel. This parameter is
evaluated in accordance with Bouguer's law, combining molecular absorption and
scattering with absorption and scattering by aerosol particles. The areosol
contribution to attenuation is evaluated on the basis of a single universal
parameter, namely the meteorological visibility range. Into account is taken
the effect of atmospheric turbulence on both diffraction and refraction of
light. For calculation of the reliability is needed the probability distribu-
tion of energy losses in the atmospheric channel. The probability of the
losses exceeding the acceptable threshold level can be easily found when the
general law of their probability distribution is known. The procedure has
been formalized in a 9-step algorithm which yields both signal attenuation and
system reliability for given transmitter output power and minimum receiver
input power. The design problem of ensuring a prescribed level of interfer-
ence immunity is not considered here and the minimum receiver input power is
assumed to have already been determined. Tables 4; references 14: 12 Russian,
2 Western (both in Russian translation).
[232-2415]

SELECTION OF SIGNALS FOR DIGITAL OPTICAL CHANNEL

FEDOROV, S. Ye. and MART'YANOV, A. N.

[Abstract] Optimum selection of signals for digital optical communication
channels is considered on the basis of the maximum likelihood difference rather
than the Bayes average risk as criterion. One among M>∞ equiprobable ones is

to be sent into the channel within a time interval $0 \le t \le T$. The detection process in the receiver is treated as testing of hypotheses according to the quantum theory, namely as a sequence of three operations with the electromagnetic field of signals and interference describable by nonnegative-definite operators in the Hilbert space. The first operation, measuring this electromagnetic field in subspace A of the Hilbert vector space H, is followed by calculation of the likelihood functions, which are then compared with one another for selection of the signal with the largest one. In the case of ambiguity it is necessary to randomize the selection. Synthesis of such a receiver requires maximization of the likelihood difference, which is done with the aid of the Bunyakovskiy-Cauchy inequality, considering that a linear functional is not optimizable by classical methods. It is done first for the simplest case of $M = 2$ signals and then for the general case of arbitrary $M > \infty$ signals. With an optimum receiver available, signals with random phase are thus selected for a channel with thermal noise. Optimization of such signals for a channel without thermal noise on the basis of minimum mean error probability or on the basis of maximum likelihood difference yields orthogonal signals, while optimization for a coherent channel yields antiphasal signals. References 8: 7 Russian, 1 Western (in Russian translation).
[217-2415]

COMPARATIVE ACCURACY EVALUATION OF LIGHT INTENSITY MEASUREMENT BY METHOD OF SINGLE-ELECTRON PULSE COUNT AND METHOD OF CHARGE STORAGE

ASTAFUROV, V. G. and GLAZOV, G. N.

[Abstract] Two principal methods of light intensity measurement in experimental physics and many other applications are compared with respect. These methods are single-electron pulse count using a photomultiplier with a discriminator-shaper and charge storage using a photomultiplier with an integrator and a memory. Dead time in the photoreceiver and the statistical distribution of the pulse count in the first method have been determined by simulation on a BESM-6 high-speed computer, assuming a gamma distribution of the luminous energy collected by coherent aperture cells in a Gaussian light field of laser radiation scattered by the atmosphere and consequently a negative-binomial distribution of the pulse count. The mean-square recording error is estimated for each method on the basis of respectively applicable relations. The results indicate that, with all pertinent parameters fixed, there always exists a light intensity level measured with the same accuracy by both methods. Intensities higher than that are measured more accurately by the charge storage method and intensities lower than that are measured more accurately by the pulse count method. The authors thank S. A. Danichkin for indicating the need to compare the two methods. Figures 4; references 17: 10 Russian, 7 Western.
[217-2415]

NONRECIPROCAL ACOUSTOOPTIC EFFECT IN MEDIUM WITH LARGE DISPERSION OF
DIELECTRIC PERMITTIVITY

ZIL'BERMAN, G. Ye., PROKLOV, V. V., KUPCHENKO, L. F. and GOLTVYANSKAYA, G. F.

[Abstract] The nonreciprocal acoustooptic effect, resulting from diffraction
of two oppositely propagating light waves by ultrasound, is analyzed for the
simplest case when it occurs in an isotropic medium and is related to the
mechanism of Bragg reflection by a vibrating crystal lattice. Including the
dispersion of dielectric permittivity reveals that the dependence not of the
light wave vector but of its product by the optical refractive index on the
acoustical frequency is the determining factor. The wave equation is solved
on this basis with the aid of Fourier series expansion of the electric field.
The solution reveals an amplification of the acoustooptic effect when the
refractive index increases with increasing acoustical frequency, which
corresponds to normal dispersion and an optically transparent medium.
Figures 4; references: 5 Russian.
[217-2415]

EFFICIENCY OF COHERENT RECEPTION OF OPTICAL SIGNAL PROPAGATING THROUGH
TURBULENT ATMOSPHERE

BUREYEV, V. A., KIRAKOSYANTS, V. Ye. and LOGINOV, V. A.

[Abstract] A multichannel heterodyne receiver with a compound telescope is
considered for coherent reception of optical signals propagating through a
turbulent atmosphere, each of its N identical channels consisting of an
entrance lens with a filter before the heterodyne and a photodetector followed
by an intermediate-frequency filter and an envelope detector behind it. The
efficiency of such a receiver is calculated on the basis of two alternative
models, with a random phase only in the first model and with not only a random
phase but also a random amplitude subject to Rayleigh fluctuation in the
second model. Both amplitude and phase are normally distributed over each
subaperture and the mean phasefront slope is normally distributed over the
aperture, in the "method of refracted waves" approximation. Calculations on
the basis of the first model yield a lower missed-hit probability at a fixed
false-alarm probability, except in the range of few photodetector readings
where it is equal to or higher than according to the second model. A compari-
son with a single-channel receiver indicates a much higher detection efficiency
of a multichannel one in terms of missed-hit probability, the optimum number
of channels being selected on the basis of maximum signal-to-noise ratio.
Figures 1; references 6: 4 Russian, 2 Western.
[217-2415]

INDUSTRIAL ELECTRONICS AND CONTROL INSTRUMENTATION

BANK OF THYRISTOR CONVERTERS IN STP 25/230-4UKhL3 CABINET

CHIKHACHEV, N. P., engineer, PETROV, Ye. M., engineer, and LYKOV, N. B., engineer, Scientific-Industrial Association "Sibtsvetmetavtomatika" (Automation of Siberian Nonferrous Metallurgy

[Abstract] A bank of thyristor converters together with a cabinet has been designed and built as power supply for the EMU-D electric drive in the Razdolinsk Periclase Production Plant, where electrical-grade commercial periclase is smelted from natural magnesite in steel melting OKB-955 revolving electric-arc furnaces. The thyristor bank is designed for stability over wide ranges of line voltage (from -40% to +20% nominal) and ambient temperature (from -45°C to +40°C), under a relative air humidity up to 95%. The converter package includes a 380/400 V transformer, pulse shaping and phase shifting circuits, tachometer and speed regulator, current limiter and overcurrent protection, automatic switches and control logic. All this equipment is packaged and mounted in the STP 25/230-4UKhL3 cabinet. Pilot operation of the first experimentally built unit over a period of three years has been highly reliable, without a single failure, and has contributed a saving of 30,000 rubles annually to the plant economy. Figures 4.
[225-2415]

ENERGY-CONSERVING TECHNOLOGY IN CHEMICAL INDUSTRY

CHURAKOV, S. D., engineer, Ministry of Chemical Industry

[Abstract] The strategy for energy conservation in the chemical industry is improving conventional technological processes, introducing more energy-efficient production methods, developing high-tonnage production with optimized process sequence, inventing fundamentally new technologies, and using nonconventional fuels or other energy sources. All these measures involve plant and equipment redesign, which should include computer-aided process and control automation. Use of secondary energy sources plays a significant role in the overall energy conservation program and ties in with development of new technologies as well as with improvement of present ones. Typical examples

are production of caustic soda, methanol, and low-density polyethylene--all high-tonnage items. In high-tonnage production, where the economic factor is particularly important, introduction of any new technology must heavily compete against improvement of the present one. Nevertheless several innovations appear to be very promising, namely: 1) use of highly efficient catalysts; 2) single staging of processes in accordance with the principles of continuity and compatibility; 3) restructurization of the raw materials base with a shift from petroleum-base materials to CO/CO_2-base materials, coal reprocess-ing products, and fossil materials; 4) new processing methods such as photo-chemical, plasmochemical, radiation treatment, and membrane methods. Typical examples here are production of vinyl chloride, formic acid, and chloromethanes, where a changeover to new equipment and new methods such as catalytic or selec-tive processing can reduce the energy content by 10-35%. Among the most recently developed membrane methods are ultrafiltration, reverse osmosis, and electrodialysis. Electrodialysis is already successfully used for water puri-fication. In production of low-density polyethylene at the Prikum Plastics Manufacturing Plant a changeover from liquid-phase to gaseous-phase processing has reduced the per-unit energy consumption by 33%.
[229-2415]

AUTOMATIC CONTROL OF ELECTRIC ENERGY CONSUMPTION IN LARGE INDUSTRIAL ENTERPRISE

LEPORSKIY, V. D., candidate of technical sciences, ZAMIDRA, V. I., engineer, and FILATOV, A. G., engineer, Kiev Polytechnic Institute imeni Semi-centennial of Great Socialist October Revolution

[Abstract] A first-generation automatic system for controlling the consumption of electric energy in large enterprises, with software developed and designed at the Kiev Polytechnic Institute, is operating in the "Uralasbest" combine since 1982 and contributes an average 14% annual saving of electric energy. The combine consists of several large users of electric energy, namely open-pit asbestos mines, asbestos enrichment facilities, machine shop, and transportation equipment. Electric energy is supplied to the combine from an intricate interconnected system of transformer substations and dis-tribution points through underground cables and overhead lines. The functions of the automatic control system are gathering and preliminary processing of operational data, commercial and technical logging of used electric energy, recording peak active and reactive power as well as deviations from limits on the basis of half-hour accounting periods. The task of this system is not only to account and monitor the consumption of electric energy by the combine but also to monitor and predict the performance characteristics of the elec-tric power supply during peak load hours. All programs are written in MNEMOCODE language for an M-6000 control computer. Figures 2; references: 3 Russian.
[229-2415]

ADAPTIVE ELECTROMECHANICAL SYSTEMS WITH INDIRECT DISCONTINUOUS CONTROL

BORTSOV, Yu. A., doctor of technical sciences, and YUNGER, I. B., candidate of technical sciences, Leningrad

[Abstract] The paper proposes an approach to the construction of invariant adaptive control systems for nonlinear electromechanical objects, based on the use of sliding (skol'zyashikh) regimes with indirect discontinuous control. A block diagram of such a system and the mathematical basis of the approach are presented. The block diagram of an adaptive governor is also shown. The practical serviceability of the proposed algorithms for the adaptive control was confirmed by experimental-industrial tests of a rotational speed adaptive control conducted by the firm "SKET" (German Democratic Republic). The regulator is distinguished by a simple technical realization. A law of adaptive control is presented which assures programmed control of electro-mechanical objects. Figures 3; references: 7 Russian.
[218-6415]

HIGHLY DYNAMIC ELECTRIC DRIVE WITH SYNCHRONOUS MOTOR AND DEPENDENT CURRENT INVERTER

BELOSHABSKIY, V. V., BOGOMOLOVA, G. A., VEYNGER, A. M., VINITSKIY, A. L., MALKIN, A. I., TIKHONOV, A. V., SERYY, I. M., and SHIGIN, V. M.

[Abstract] The possibility is considered of developing a highly-dynamic electric drive on the basis of a synchronous motor with a dependent current inverter (not giving way with respect to the dynamic properties of contempo-rary electric drives), based on a synchronous motor with NPCh (lowest appli-cable frequency) and a system of automatic regulation of a subordinate type. This involves the condition that in the automatic regulation system, the dynamic properties of such complex objects as a synchronous motor and a dependent circuit marker are considered sufficiently completely. On the basis of a generalized block diagram the principal possibility is shown of develop-ing the highly-dynamic electric drive under consideration. In addition, the block diagram of a system of automatic regulation was obtained, within the scope of which the problem indicated above can be solved. Figures 5; references: 3 Russian.
[218-6415]

INSTRUMENTATION AND MEASUREMENTS

DESIGN OF NONLINEAR WIDEBAND PHASE-LOCK AUTOMATIC TUNING SYSTEMS

KRAVCHENKO, B. A.

[Abstract] Nonlinear control elements are considered for phase-look automatic tuning systems in frequency synthesizers, in which the parametric transconductance of the control-voltage generator changes by a large factor even when the tuning range is narrow. It increases, moreover, as the tuning range ratio is decreased by increasing the nominal capacitor size in the control circuit. Four such circuits and their characteristics are described, parallel inductance-varactor filters: 1) plain; 2) fixed capacitor also in parallel; 3) fixed capacitor in series between inductance and varactor diode; 4) fixed capacitor in parallel with inductance and fixed capacitor in series with varactor diode. The author thanks Doctor of Technical Sciences D. N. Shapiro for helpful comments.
[232-2415]

CALCULATION OF THE OUTPUT CAPACITANCE OF A THREE-ELECTRODE CONVERTER

STRUNSKIY, M. G. and GORBOV, M. M.

[Abstract] Exact and approximate formulas for calculation of the capacitance between the high and low potential electrodes of a converter with various capacitive connections between the controlled conductor and shield are obtained by means of the complex potential method and direct determination of the field intensity. The precision of the calculated formulas is analytically and experimentally determined. The conditions are determined with which introduction of the controlled conductor into the converter does not change its capacitance. Choices of the structural parameters of the converters and the conditions of their operation are recommended. Figures 5; tables 3; references 12: 10 Russian, 2 nonRussian
[272-6415]

CALCULATION OF THE INTEGRAL PARAMETERS OF AN ELECTRODE SYSTEM CONSISTING
OF TWO HOLLOW SPHERICAL SEGMENTS

ZAKHAROV, A. G., engineer, KADNIKOV, S. N., candidate of technical sciences,
and YURKEVICH, V. M., candidate of technical sciences, Moscow Power
Engineering Institute

[Abstract] In a calculation of the integral parameters of an electrode system
consisting of two hollow segments, consideration is given to thin casings
(obolochka) which are basic elements of electric field pickups, variable
capacitors, electrostatic shields, and electrooptical systems. Solution of
electrostatic problems for such a family of electrode systems presents con-
siderable difficulties caused by the necessity for calculation of the edge
effect. In this case the method finite differences requires construction of
a special curvilinear net with a considerable degree of bridging close to the
edge of the electrode, and this by itself is a rather complex problem,
especially in the three-dimensional case. For thin casings, the method of
integral equations of the potential theory reduces to an equation of the first
type, the numerical solution of which is an improper solution and gives low
precision. As long as the initial boundary of the electrostatic problem is
correctly presented, a method of its contraction to an integral equation of
the Fredholm property type must exist. In the axially symmetric case, for
simple type casings, such a means gives a method of dual equations. In the
three-dimensional case correct equations can be constructed with the aid of
Green's functions. A system is formulated with the aid of which the capaci-
tor capacitance of an electrode system and the voltage between electrodes,
existing in an external field (no-load voltage) can be computed. The capaci-
tance was calculated by the method of capacitance coefficients. References:
3 Russian.
[218-6415]

USE OF INDUCTIVE ENERGY STORAGE FOR ACCELERATION OF CONDUCTING BODIES

CHEMERIS, V. I., candidate of technical sciences, PODOL'TSEV, A. D.,
candidate of technical sciences, VAS'KOVSKIY, Yu. N., candidate of technical
sciences, and PETROVSKIY, V. P., engineer, Institute of Electrodynamics,
Academy of Sciences, USSR

[Abstract] The necessity for careful matching of inductive storage with a
load, the inductance of which changes in time, is noted in a 1981 paper by
G. A. Shneerson, where the operation of a conduction accelerator was studied.

With consideration given to this paper and using an electronic computer, the authors of the present paper performed modelling of induction-dynamic acceleration of a conducting armature in a pulsed magnetic field of a solenoid, in order to determine the influence of the parameters of an electroexplosive release and the ratio of inductances $Y_1 = L_c/L_n$ of the solenoid and the storage, on the efficiency of the energy conversion, stored up in the magnetic field of the storage unit, in the kinetic energy of the armature. Figures 4; references 7: 6 Russian, 1 Western.
[218-6415]

EFFECTIVENESS OF SHIELDING A CAPACITOR PLATE

RUDAKOV, V. V., candidate of technical sciences, Kharkov Polytechnical Institute

[Abstract] The electrical field is determined in a "system of plates" shield-- a plate shielded for evaluation of the electric strength and a choice of an optimum relationship of the dimensions of the system under consideration. It is experimentally and theoretically demonstrated that in the design of a capacitor type with a shield, in the case of $l/d > 1$, the high effectiveness of shielding, i.e., the maximum electric strength, with an invariable distance between a shielded plate and a plate of opposite polarity, is achieved with such an arrangement of the shielded plate and a shield, in which the distance between the latter amounts to 38-41% of the distance between the shield and the plate of opposite polarity. Figures 4; tables 1; references 6: 4 Russian, 2 Western.
[218-6415]

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